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THE MILK REORGANISATION COMMITTEE REPORT AND THE VETERINARY PROFESSION.

THE Report, recently issued, of the Milk Reorganisation Committee, has naturally given much food for thought amongst the members of the veterinary profession whose duties include those of either Ministry or County Inspectorship. Its measures, when brought into effect, will be far-reaching, but that some further controlling action is badly needed to effectively deal with the ravages of tuberculous infection, is universally agreed; and if any other proof is necessary, it is to be found in the numerous published reports of the Health authorities. For further evidence one has only to read the remarks made during lay discussions whenever the allied subjects of pure milk and tuberculosis in cattle are brought up.

In the recent report of the Chief Veterinary Inspector for Glasgow it is recorded that 14.5 per cent. of the milk samples tested by him contained virulent tubercle bacilli, and that *many* infected cows were sent to the city market for sale. And the Glasgow report is typical of many others. This, in this enlightened year of 1933, would seem incredible did we not all know it to be a statement of true fact. Unfortunately it deepens the reproach against Great Britain; and, indeed, in these matters we are a long way behind other countries.

At the forthcoming combined meeting of the members of the Royal Counties, South-Eastern and Central Divisions of the National Veterinary Association the whole situation will be thrashed out dispassionately, from A to Z; and within a very short time discussions will have taken place by the members of every veterinary society in the kingdom. As the result definite resolutions will be sent to the N.V.M.A. headquarters, where they will be considered by the Council; and it is hoped that some united action will be taken; with the result that eventually there will be complete eradication of this terrible scourge which is so far-reaching in its devastating effects on man and beast.

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General Articles

STERILITY IN THE COW: SOME OBSERVATIONS ON CAUSES OF THE CONDITION MOST FREQUENTLY ENCOUNTERED IN THE PRACTICE OF VETERINARY MEDICINE.*

By J. F. D. TUTT, F.R.C.V.S.
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(Continued from our last issue.)

Nymphomania.

Ætiology.—In many instances the condition is traceable primarily to the overtaxing of the system of the cow by excessive and injudicious feeding on a high protein ration for high milk production. In some herds it is met with in the virgin heifers which have been brought up in an exceptionally fat condition. In discussions that have taken place from time to time in veterinary circles regarding the ætiology of this disease, it has been stated by some clinicians that tuberculosis is often responsible for the condition. It has not been noticed that tuberculosis influences œstrus until the ovary is involved, when it may cause cystic degeneration of the Graafian follicle, resulting in nymphomania. In general practice one finds nymphomania so frequently in the absence of tuberculosis that there is little doubt that it is only one of the causes which results in nymphomania. It is fairly evident that the anterior pituitary, in conjunction with the ovary, is concerned in the regulation of the œstral rhythm, but it would appear that defectiveness of the adrenal plays an important rôle in this glandular syndrome known as nymphomania. There is some indication in the advanced case of nymphomania with the bull-like head and voice and the coarse hair, that there may be some hyperfunction of the anterior pituitary, but there is nothing very definite to go upon. At least, in woman a similar syndrome has been reported in connection with adrenalin disease.

There would not appear to be any evidence of hypersecretion of the medulla of the suprarenal, but there may be, at least in some cases, a hypersecretion of the cortex. The development of the male-like features in the female suggests either the involvement of the cortex of the adrenal or of the anterior pituitary body. Dysfunction of either of these glands would serve to explain some of the symptoms present, and this is particularly so in regard to the anterior pituitary. To say, however, that the anterior pituitary body dominates the ovary is carrying the argument a little too far. It is rather that, together with other endocrine

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glands, it serves to regulate the action of the ovary, and that it is a varying imbalance of these various endocrines that brings about the marked variations that are seen in the symptomology of nymphomania. The anterior pituitary has the tendency to promote the formation of follicles, or rather the maturation of the follicles, in the ovary. Following the rupture of these follicles, the formation of a corpus luteum is the normal course of events. There is no evidence, so far as is known, which shows that the formation of corpora lutea is the result of anterior pituitary action in a normal animal following the rupture of a normal ovisac. Now in the case of a nymphomaniac cow there is an excessive formation of follicles and of follicular fluid, and therefore excessive " heat." Why is it that these follicles fail to rupture, and why is it that corpora lutea are not found in these cases? So far as the ovum is concerned, it is probable that the fundamental defect is due to the formation of abnormal liquor folliculi. Some experiments have shown that in the normal liquor folliculi a proteolytic ferment is present, and that this ferment has much to do with the ultimate rupture of the follicle. Along this line a little research work would be useful. One might argue that if anterior pituitary extract was given in these cases it would cause the formation of a normal ovisac, and that this would rupture naturally, and a corpus luteum would be formed as the natural course of events, and that the cow would be well. That is all perfectly true with the healthy animal, but with the nymphomaniac cow one would hesitate so to stimulate an already over-stimulated organ. At the last International Veterinary Congress in London, Dr. Frei, of Zurich, postulated the theory that cows suffering from nymphomania probably had an ovotestis, but he did not produce any evidence to support this theory, and it is apparently negatived by those experts who have made histological examinations of the parts concerned. Quinlan, in a private communication, flatly repudiates the theory, having carried out extensive investigations on a large number of nymphomaniac cows in South Africa. In cases of nymphomania, as in normal œstrus, it would appear that the blood calcium is increased. The figures found by Emmerson in this connection were reported in the *Veterinary Record* (p. 741, 1931). It has to be recollected that at the end of a normal œstrus the ovisac ruptures and œstrus subsides. In cases of nymphomania the mechanism of this procedure becomes deranged in that the follicle fails to rupture, the ovum is not liberated, and fluid continues to collect within the follicle wall, forming a cyst. More follicles form and fail to rupture, and in time the affected ovary becomes a mass of cysts, and in cases of nymphomania, when the cysts are well established, the affected cow may show continuous heat.

Symptoms of Nymphomania.—The earliest symptom is an irregularity in the œstrus cycle which later develops into more or less continuous heat. As the disease progresses it will be noticed that the sacro-sciatic ligaments become relaxed and sunken, and the root of the tail becomes markedly elevated, leaving a depression on either side; the back becomes hollow, and the voice may resemble that of the bull. There is a progressive loss of condition, and excessive sexual desire is usually present. This manifestation of aggravated sexual desire may be of

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a violent nature, the affected animal mounting all the members of the herd; on the other hand, the affected animal may be subdued in this respect, but yet be prepared to accept service by the bull at any time. On account of the slackening of the interosseous ligaments when the sacral symptoms become pronounced, very often a scraping noise, resembling the crepitus heard in cases of fracture, is detectable. Fractures in this condition are not uncommon owing to the loss of calcium through the constant functioning of the ovaries; in short, a condition of osteomalacia is present. Externally the vulva appears flabby and relaxed, like that of a cow close on calving, and will readily admit the hand. In the vagina there is usually an abundant supply of mucus which varies in intensity and consistency, according to the extent and nature of the cervicitis and endometritis, which are present as fairly constant features of the disease. The os uteri externum of the cervix is as a rule widely dilated, the spiral nature of the canal is lost, and the finger is readily admitted. Rectal examination will reveal a cystic condition involving one or both ovaries, which may be greatly enlarged owing to the cysts present. Salpingitis may or may not be present, no corpora lutea can be detected in the ovaries, and the uterus will be found to project beyond the pelvic girdle.

Treatment.—The success of treatment, as in all cases of sterility, will depend upon the early rectification of the cause. The ovarian cysts should be ruptured by pressure exerted per rectum. As a general rule this is not a difficult matter with cysts which are more or less on the "surface" of the ovary; but difficulty may be experienced, and considerable pressure necessary to rupture any that are deeply placed in the ovary. In such cases the affected ovary should be grasped and brought back over the vaginal roof, where more pressure can with safety be exercised. If pressure should fail, then the cyst should be punctured by means of the point of a scalpel, or a trocar, inserted through the vaginal roof. Where all these measures fail, and if one ovary only is involved, good results often follow its removal in entirety, *i.e.* ovariotomy. Very often it will be found that the left ovary is more frequently deeply involved than the right, and as right-sided conception is far more frequent than left, ovariotomy is often attended with complete recovery, providing, of course, that gross lesions are not present in the Fallopian tubes and uterus.

In addition to the treatment given for ovarian lesions, those existing elsewhere must receive attention, and the endometritis treated according to its degree. It has been found that two intramuscular injections of a preparation known as "Contramine," in dosage of 2 c.c. at intervals of six to seven days, is a useful adjunct. It is a chemico-therapeutic product with definite bacteriolytic action, especially on the *Br. abortus Bang*. Thyroid extract can be usefully administered in the food in obstinate cases. A diet of crushed corn and bran should be given, and a satisfactory ration for a cow seriously affected with nymphomania consists of four parts of crushed oats, two parts of bran, and from half to one part of linseed cake. In addition, four ounces of steamed bone flour and a few swedes may be given.

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A cow with nymphomania should be isolated from the rest of the herd owing to the risk of fracture arising from bones rendered poor in calcium content. No attempt at breeding should be made until her second normal heat. This golden rule is to be observed in all cases associated with irregular œstrus, and, one might add, with endometritis even when œstrus is regular. Dr. W. W. Williams, of Springfield, Massachusetts, U.S.A., now treats cases of nymphomania by the injection of adrenalin chloride and pituitary (posterior lobe) extract. I have described his methods and recommendations in the *Veterinary Record* (p. 521–523, 1932). He states that he has used this line of treatment on at least 700 cases, and that the recoveries have exceeded 70 per cent.

The Manifestation of Œstrus Under or Above the Normal Period.

In these cases the affected cow may come into œstrus ten days after the last, or a period that varies for 14 to 20 days may be followed by one of 21, 22, or 23 days. In cases of cystic degeneration of the corpus luteum, if the degeneration is rapid, the cow may be in œstrus again in 8 to 15 days, or œstrus may be delayed for 30 days or more. Ovulation occurs when the lutein cells disappear, and as the cyst develops the interovulation period is reduced.

Ætiology.—In these cases the irregularity is usually traceable to infection from the uterus.

Symptoms.—The symptoms of sexual excitement—progressive emaciation and external alterations in the genitalia—are absent. The cow as a rule does not lose condition, in fact she may put on flesh, and in the ordinary course of events is fattened off and sold as a " barrener." In the case of the ovaries, the cysts or " bladders " are usually not so large as those met with in cases of nymphomania, and their origin is in all probability confined to the corpus luteum.

Treatment.—The cysts are to be ruptured as described under the preceding disease, uterine treatment carried out if necessary, and service postponed until the second normal heat. Contramine is of value as an adjunct to the treatment. If when œstrus becomes normal conception does not follow, injections of wheat germ oil may prove of value. This preparation will be described later.

The Absence of Œstrus for an Indefinite Period and then a Re-occurrence.

Ætiology.—Although it is possible to compare those cases met with in the cow, where the previous manifestation of œstrus has not been followed by service, with cases in the human female which are ascribable to a functional amenorrhœa, these cases are so very rarely met with in general veterinary practice that they do not merit attention, and it can be stated that so far as veterinary practice is concerned the ætiology of this condition is usually associated with an endometritis which may be of a pathological or atrophic nature.

Symptoms.—The cow comes into œstrus several weeks or even months after her last service. In such cases it is feasible to suppose that conception did take place, but that owing to the intolerance of an irritable or atrophied endometrium,

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the fœtus or fertilised ovum was lost at an early stage. In these cases the ovaries are usually normal.

Treatment.—The endometritis must be treated. When this has been cleared up, injections of wheat germ oil (which contains vitamin E) should be given intramuscularly in doses of 25 c.c. per injection prior to service, and at intervals of six to seven days for six weeks afterwards, or until such time as conception can be diagnosed clinically and is well established. In the case of the human female, and in the bitch, injections of corpus luteum extract have proved of value in maintaining pregnancy in these early stages, but this preparation has not yet been tried on the bovine female.

Slight Manifestation of Œstrus.

(1) *Shy Breeding.*—In these cases the cow is only in œstrus for a few hours, and more often than not the clinical signs are so slight that they are overlooked. The term " shy breeding " has been applied to this condition, and there is no clinical or post-mortem change in the genitalia. The " Duchess " strain of Shorthorn cattle became extinct through " shy breeding," and the cause in all probability is entirely of a functional nature, and not the result of hereditary predisposition to pathological lesions of the genitalia. Pugh[4] has pointed out that in his district some stockmen carry out udder inflation, as is practised for milk fever for treating this condition, and he puts forward a scientific justification for their empirical treatment by pointing out the close relationship of the udder tissue to the genital apparatus. In such cases, turning the cow out with the bull is often followed by conception. A bull is an adept at detecting the manifestation of œstrus, and his ability in this regard is a problem which should be capable of a satisfactory explanation.

(2) *Silent Heat.*—In this condition ovulation takes place, but œstral symptoms are not shown. The condition can only be diagnosed by a rectal examination of the ovaries at frequent intervals, which will show by the presence of freshly formed corpora lutea or maturing ovisacs that ovulation has taken place during the intervals between the examinations. It occurs more frequently than one is led to suppose, and this fact is one reason for not resorting to the reckless squeezing out of corpora lutea found on a first examination, on the assumption that they are of a persisting nature, and inhibiting ovulation and œstrus. In these cases the cow should be turned out loose with the bull. This plan has proved successful on no fewer than five cases encountered during the past fifteen months.

Absence of Œstrus.

Ætiology.—This condition may be due to any of the following factors: (1) A persisting corpus luteum, accompanied or not with definite lesions elsewhere, such as pyometra. (2) Functional—in which the ovaries remain static for an indefinite period, and there are no demonstrable lesions in other parts of the genital tract, and which may be due to an hereditary cause. (3) Any emaciating disease, such as Johne's disease, tends to inhibit rather than to excite œstrus.

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Occurrence.—Absence of œstrus has been observed by me in heifers that have never been served. It is a generally accepted fact that the cow that is a heavy milker comes into œstrus more tardily than the cow that is a light milker. The early weaning of calves has been mentioned in this connection, and it is held that it is not conducive to a high fertility-rate to remove calves at birth and bring them up by hand. An analogy in this connection has been drawn with the human female, who does not menstruate for the first four to six months after childbirth; but analogy stops, inasmuch as the milk does not fail in the bovine, and is drawn off by hand. It may be that the mental effect of suckling the calf and the companionship have some influence in hastening uterine involution, which is in all probability excited by the suckling of the calf. The whole matter depends a great deal on the temperament of the cow. It must be remembered that although obvious signs of œstrus may not be shown clinically, ovulation may have taken place, and frequently does so.

Symptoms.—These are that the clinical signs of œstrus are not shown. In those cases which are due to a persisting corpus luteum a rectal examination should reveal the presence of this body as a distinct protuberance on the ovary. It has been defined as "fleshy." In cases where pyometra is present, and when the retained body has sunk deeply into the ovary, it will, when the affected ovary is manipulated, feel like a stone inside a cherry. This definition may not be very scientific, but it suffices for practical purposes. In cases which are due to functional causes, rectal examination of the ovaries reveals no abnormality; neither corpora lutea nor ovisacs can be detected. On the other hand, the ovaries may be abnormally small, *i.e.*, atrophied through disuse. In heifers the uterus may appear undeveloped, *i.e.*, calf-like.

Treatment.—This will depend upon the cause:

(1) *Persisting Corpus Luteum.*—Before definitely deciding whether a corpus luteum found on rectal examination is a persisting one or not, a definite diagnosis should not be based upon one examination unless such gross lesions as a pyometra are present. The ovaries in all cases of doubt should be examined at intervals of seven to ten days. The argument in favour of this advice is the undoubted fact that the so-called "silent heats" already described occur far more frequently than one is led to suppose, and it has to be remembered that both follicles and corpora lutea are normal to the ovary, and that their removal, unless specially indicated, may be injurious to the cow. Providing that the case is one of simple persisting corpus luteum and there are no demonstrable lesions elsewhere, squeezing out the retained body will bring on œstrus within two to five days. Œstrus has been observed as early as the twenty-fourth hour, but it would appear that the general rule has been that it occurs within three to four days, and in one particular case when a macerated fœtus was found on rectal examination of a reputed sterile cow, abortion followed within forty-eight hours of squeezing out the corpus luteum. If lesions are present in other parts of the genital tract, attention should be directed to them first, as, except in mild cases of uterine

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catarrh or endometritis, squeezing out a retained corpus luteum has not been found to effect a complete return to normal conditions. In fact, when dealing with the varying forms of endometritis, it has been observed that as the uterine condition clears up, the corpus luteum either disappears or becomes so far re-absorbed that it no longer inhibits œstrus.

(2) *Functional.*—This depends upon the cause, and as a rule is not satisfactory. In some cases ovarian and uterine massage can be carried out at frequent intervals, together with the injection of suitable ovarian extracts, with the administration of thyroid extract in the food. Attention should also be directed to the diet. A heating ration of oats and beans is not so good for fertility as green nutritious food. The use of a ration of mashes and roots, along with corn rations, puts the dam in the right condition to conceive. Good results have been attained in some cases on this line of treatment. The preparation known as "Theelin" (Parke Davis), which is an extract of the ovarian follicular hormone, has proved of value in selected cases in inducing œstrus. The preparation has been used both as an injection and in pessary form. In one particular case two injections, each of 5 c.c., given at an interval of four days, were followed by the onset of œstrus on the fourth day following the second injection. The unsatisfactory results that often follow treatment are ascribable to the atrophic changes which have taken place in the endometrium through the previous long absence of œstrus. To counteract this resort may with advantage be had to injections of wheat germ oil, as previously alluded to, and in which quite a fair proportion of carefully selected cases have proved of value.

In those cases which can be ascribed to hereditary causes treatment is hopeless. Certain strains of cattle, like certain human races, tend to die out, this process being due to a progressive failure of reproductive activity in some cases ; in others to hereditary disease. The great tendency to inbreeding, especially in some strains of the Channel Island breeds, is often accompanied by a high degree of sterility. During the past eighteen years two instances of this have been noticed : one in a Guernsey herd, the other in a Jersey. In the case of the Guernsey herd, the owner resolutely refused to buy in any stock unless it came of the particular strain of the rest of the herd. For a few years all went well, but during the past five years of the herd's existence the sterility-rate, especially in the heifers, was a very high one. The predominant clinical feature in the young heifers was an absence of œstrus, and no pathological abnormality could be detected. In the case of the cows sterility occurred early, and here again the chief clinical symptom was an absence of œstrus. The Jersey herd was exceptional in that it had been imported from Russia, and the experiences were exactly the same as those of the Guernsey herd, and although in some cases calves were born after treatment with glandular extracts and ovarian and uterine massage, they themselves proved absolutely sterile.

Turning an affected animal out with the bull has sometimes had the desired effect of securing conception, but should all these measures fail, grafting may be tried.

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Grafting.—The procedure adopted in grafting is as follows : The donor selected should be as young as possible. Calves six months to one year old make the best donors, as there is little fibrous tissue formation in the ovary because of the few times that ovulation has occurred. The box in which the operation is to take place should be bare, without any bedding, and well washed down with disinfectant solution, and left damp to prevent dust flying about. The patient should be prepared by shaving the skin of the site selected, and painting the shaved area with tincture of iodine. The neck and pectoral muscles make the best sites, owing to the better blood supply and the consequent provision of better anastomosis for the grafts. The sites having been prepared, a local anæsthetic (such as cocaine hydrochlor., 5 per cent.) is injected. The ovary of whichever side has been prepared is now removed from the donor (it must be emphasised that the donor must be destroyed at the time of operation to ensure freshness of the grafts). In general practice it has been the custom to graft the left ovary into the left side of the recipient, and the right into the right side. The ovary is removed from the abdomen of the donor, and placed on a sterile swab kept as near blood heat as possible. The capsule of the ovary (which is distinct) should be removed, taking care not to injure the underlying interstitial cells more than can be avoided, also removing as much of the fibrous tissue of the ovary as possible. The ovary is then divided into two or more suitable sections (two are about as many as can be obtained from one ovary), one section for the neck, and one for the pectoral muscles. The skin of the recipient is now incised, and a piece of muscle tissue sufficiently large enough to accommodate the graft removed. The prepared section is then placed in this muscle " pit " and the edges of the muscles secured with one catgut suture. The skin wound is also closed with a single catgut suture, or more if necessary. Repeat the process on the other side. Hot saline compresses are now applied to the operation sites to promote blood supply, and finally boracic powder is dusted over the wounds. The hot compresses are repeated twice daily for three days. Strict cleanliness must be observed throughout the operation, and good sterilised rubber gloves (such as the Miller Anode Surgeon's Gloves) should be worn, and the instruments kept, except when actually in use, in a steriliser.

It has been found that unless the ovary is completely stripped of all the capsule and redundant tissue, there is very little chance of anastomosis taking place, and consequently failure of the graft to grow. In advising treatment by grafting, the following considerations must be borne in mind :

(1) That in heifers that have never been pregnant, and have not shown clinical signs of œstrus, and where there is no evidence from rectal examination of the ovaries that ovulation has taken place, grafting is not likely to prove of value. (2) That in spite of statements to the contrary, it is advisable that calves of the same breed as the recipient should be chosen where and when possible. (3) That there must be no evidence of uterine catarrh or disease in any part of the genital tract. Should there be such evidence, it must be cleared up. Grafting

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is not going to cure a pathological cause of sterility, only functional causes. (4) That the most successful subjects are those cows which have had calves, and in which sterility is purely functional and attributable to endocrine deficiency resulting from such natural causes as age. (5) That it is applicable and often successful when other measures fail, when œstrus is regular.

REFERENCE.

4. Pugh: *Veterinary Record*, Vol. 4, 1924.

(*To be continued.*)

DISEASES OF YOUNG CALVES.

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Introduction.

WHILE carrying out an experimental tuberculosis eradication scheme in Ayrshire, it was constantly being brought before the notice of the author that there were serious annual losses of calves due to disease. It was thought possible that sufficient recognition had not hitherto been given to these losses. Moreover, while many bovine diseases are receiving widespread consideration at various research laboratories and agricultural institutions, a survey of recent publications indicates that very little work is being undertaken to combat calf diseases. Both the farmers and the local country veterinary practitioners realise the importance of these diseases, and although they are constantly trying out fresh measures to lessen the losses caused by them, little headway is being made. A survey of certain farms in the area mentioned was therefore made during 1931 and the spring of 1932, in order to form an approximate estimation of the losses in calves, and to consider some of the more significant facts associated with the various diseases encountered.

Diseases Encountered and Losses Sustained.

As was expected, the two conditions which predominated were white scour and navel or joint ill. It was noticed, however, that a very large number of calves died of conditions which, while they may have been forms of either one or other of these, were typical of neither. Other calves showed direct evidence of both. In fact, taken as a whole, it was extremely difficult in many instances to draw a sharp line of demarcation between scour, navel ill, and certain rapidly fatal conditions which may have been either.

For convenience a questionnaire was drawn up which contained the more obvious factors to be considered. This was submitted personally to the various farmers for consideration. Many of the cases recorded were not seen by the author nor by the local practising veterinary surgeon, who readily offered his assistance to help to compile this survey. Consequently much of the material was obtained direct from owners, and must therefore be accepted with reserve. This is especially true where attempts have been made to distinguish between scour and navel ill. Many owners were quite incapable of making such a dis-

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tinction. It is for this reason that, throughout this paper, these two diseases have been constantly considered under the one heading of "calf diseases." The total number of farms included in the investigation was twenty-six, and of these twenty-four, or 93 per cent., experienced losses in calves during the eighteen months of the inquiry. The following Table shows the annual losses due to the different calf diseases.

Calves born during spring season, 1931	... ...	368
Calves dead—all causes	... ...	98, or 26 per cent.
Comprising Scour ...	... ...	44, or 45 per cent.
Navel or joint ill	... ...	46, or 47 „ „
Other diseases...	... ...	8, or 8 „ „
Calves born during autumn season, 1931	... ...	180
Calves dead—all causes...	... ...	15, or 8 per cent.
Comprising Scour ...	... ...	1, or 7 per cent.
Navel or joint ill	... ...	9, or 60 „ „
Other diseases	... ...	5, or 33 „ „
Total calves born during 1931...	... ...	548
Total calves dead—all causes ...	... ...	113, or 20 per cent.
Comprising Scour ...	... ...	45 or 40 per cent.
Navel or joint ill	... ...	55, or 50 „ „
Other diseases	... ...	13, or 11 „ „
Calves born during spring season, 1932	... ...	236
Calves dead—all causes	... ...	56, or 24 per cent.
Comprising Scour ...	... ...	43, or 76 per cent.
Navel or joint ill	... ...	11, or 19 „ „
Other diseases ...	... ...	2, or 3 „ „

NOTE.—Under the heading "other diseases" are included such conditions as hoose, black leg, accidents, etc.

It will be seen that in 1931, out of 548 calves born on these farms, 113, or 20 per cent., died within a comparatively short time. The greatest mortality occurred in the spring, when it reached 26 per cent., compared with only 8 per cent. in autumn. During 1932 it was only possible to make inquiries during the spring, but the same high death-rate was noticed. Of 236 calves born at this season, 56 or 24 per cent. died as very young calves. There does not appear to be any constant proportion of deaths due to either scour or navel ill. This is readily understood by the fact that the numbers dealt with are relatively small. The difficulty encountered in correct diagnosis must also be taken into account.

The important fact remains, however, that in this district at least there occur annually grave losses to the dairy industry due to diseases in young calves. There is reason to believe, moreover, that these losses are by no means confined to the district in question. There is ample proof to show that these losses are mostly due either to scour, to navel or joint ill, or to diseases closely allied with these

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conditions. It is the practice in Ayrshire that bull calves, unless kept for stock, are disposed of within two or three days. The whole of the figures quoted in this survey are only concerned, therefore, with heifer calves, and take no account of losses in bull calves.

Financial Aspect of the Losses.

Anyone casually observing the prices realised by calves in an auction market would not appreciate the financial losses actually caused by disease and fatalities in young calves. In 1931 there were 113 calves died in the area surveyed. This was on twenty-six farms, an average of four and one-third calves per farm. The average market price of an Ayrshire heifer calf is £3. This gives a direct loss of about £13 per farm per year, or a total of £338 in the very small area investigated. There are approximately 1,600 dairy herds in the county of Ayrshire. There is no reason to doubt that the losses encountered in the area chosen at random are different from those experienced throughout the rest of the country. Assuming that they are the same, the approximate annual loss from calf diseases in this dairy county alone would be £21,000. Moreover, the financial loss cannot be fully appreciated by estimating the value of calves when only a few days old. One farm in the area furnishes an excellent example of the serious consequences of these diseases. This farm carries a tubercle-free herd of pedigree Ayrshire cattle. During 1931 no less than twenty out of thirty calves died before reaching fourteen days old. These calves would ordinarily have been kept until at their calving time—probably at two years nine months to three years—and then sold, or valued at an easy average of £32 each. As heifers they would have shown a profit of approximately £14 each, or a total of £280. It will thus be seen that, at a very rough estimate, this owner lost £280 in one year, not including other losses due to deaths of bull calves, and heavy veterinary fees. The bull calves on this farm, as on many others, are in great demand for breeding purposes, and command very high prices.

Indirect Losses.—A further serious factor to be considered in these districts is that the dairy herds are almost entirely self-supporting. They depend solely on their own breeding to displace animals cast from the milking herd each year. An outbreak of disease resulting in the loss of half the female calves becomes a very serious matter by the time that these animals should have reached the calving age and come into the milking herd. The result of the calf losses is that animals which would have been disposed of, as being either unprofitable or diseased, have to be kept a further season, or even seasons, if the calf trouble persists.

It may be suggested that these calf losses could be made up by purchasing others to take their place. Apart from the expense involved, this would be a departure from the excellent practice of this district never to purchase fresh stock, except stock bulls. Most of the farms owe much of their success to the fact that they are entirely self-contained and self-supporting. A departure from the practice adopted during the past twenty or thirty years is not to be lightly considered. A large number of Ayrshire dairy farmers are attempting to establish

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tubercle-free or abortion-free herds, and most of them are relying on a method which entails the breeding of their own disease-free herds. Their method of procedure is to rear large numbers of female calves to replace their infected adult stock. A heavy death-rate among calves means delay in this object, often with serious consequences.

Outstanding Features of Calf Diseases (as dealt with in Questionnaire).

A brief discussion of the individual features of the diseases encountered is now presented :

(1) *Diseases Encountered.*—Throughout the period covered by the inquiry, the following cases of death occurred through causes other than scour or navel ill : Accident, 1 ; unthriftiness, 6 ; black leg, 2 ; hoose, 2 ; pneumonia, 2 ; aborted calves, 2. Out of a total of 169 deaths only 15, or 8 per cent., died through the above-mentioned conditions. There is a possibility that some of the unthrifty calves which died were subjected to a mild infection with one of the diseases being studied, such an attack being responsible for their ultimate condition. It is thus seen that in this inquiry the number of calves dying from causes other than those associated with scour or navel ill is negligible, the latter diseases being responsible for 92 per cent. of the deaths.

(2) *Age When Affected.*—The age at which the calves became affected varied from a few hours after birth up to one month. The average time, according to the questionnaires, was a little over seven days. It was noticed, however, that when the cause was " suspected " scour, the age was far less, the time for this being from birth to five days. " Suspected " cases of navel ill were responsible for the longer periods. In the latter cases the disease became noticeable in from ten days to a month. It is probable that sucklings suffering from this disease actually showed early symptoms before this time, but that these escaped notice.

(3) *Course of the Diseases.*—The length of time up to which affected animals survived was again very varied. In some cases death took place shortly after the first symptoms were noticed. It was a common history that a calf, apparently healthy at night, was found dead first thing on the following morning without any symptoms having been noticed. In other cases animals survived in an unthrifty condition for several days, or even weeks, before eventually dying. The average period of survival, as taken from the reports, worked out at eight days. The course of the diseases was varied, not only on individual farms, but amongst individual batches of calves. In some instances death was early, whilst other calves of similar age in the same pens remained affected for varying periods before finally succumbing, or occasionally recovering.

(4) *Mortality of the Diseases.*—Very few animals showing definite symptoms of either of these diseases recovered. The mortality appears to be in the region of 80 per cent. This varies with the severity of the attack and with the success

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of the various methods of treatment adopted. When calves are left entirely without treatment, the death-rate is appreciably higher.

(5) *Condition of Survivors.*—The ultimate condition of animals which survived was considered to be of some importance. This was found to depend almost entirely on the degree of infection. Where the symptoms were mild and the treatment effective, the calves appeared to thrive reasonably well. On the other hand, calves which only survived after a prolonged illness remained unthrifty for upwards of a year, or even longer. Most of these animals were ultimately disposed of and became untraceable. It was noticed that any animals which had been thus infected to any marked degree seemed definitely more susceptible to other diseases, such as parasitic bronchitis or tuberculosis. Several outstanding cases of this nature were encountered.

(6) *Symptoms.*—These are generally well known, but a brief description of the diseases encountered will be presented.

White Scour.—The disease derives its name from the characteristic colour assumed by the fæces. At first they are yellowish, but later the diarrhœa, which is the most striking manifestation of the disease, becomes greyish-white or putty coloured, often streaked with blood. The fæces have a peculiar putrid odour, which is almost as characteristic as the colour. At first there is considerable straining, but later the animals lose control of their evacuations. The diarrhœa pours intermittently from the anus, causing considerable soiling of the perineum, accompanied by excoriation. Colicky symptoms are also noticeable. Affected calves assume the recumbent position most of the time, and are reluctant to rise. If forced to their feet they often exhibit signs of abdominal pain. The affected animals become increasingly weaker, temperature becomes subnormal, and finally death follows a state of coma. Pneumonic symptoms are often noticed. It must not be assumed that this expected sequence is always observed. Sometimes the diarrhœa is intermittent, as are the remainder of the described symptoms. In other cases the disease runs an acute course, and the animal is dead in a few hours of what appears to be a general septicæmia. The navel and cord are frequently found to be enlarged and tender. Sometimes in protracted cases tenderness and slight swelling of the joints are noticed.

Navel- or Joint-Ill.—The calf is usually noticed to be dull and frequently lying down, often refusing its food. If the navel is examined it is usually found to be swollen and hot ; on pressure pus can often be evacuated. The joints (hocks and knees) become hot and painful, and later œdematous swelling is noticeable in them. A state of general metastatic inflammation of the lungs frequently accompanies these conditions, as does an offensive diarrhœa. Sudden deaths are again sometimes observed without any characteristic symptoms being noticed. Only the infected navel and cord noticed at autopsy indicate the nature of the disease. The temperature during this disease is usually higher than during scour. As has been stated elsewhere, many calves exhibit no definite symptoms such as those described. They are dull, eyes retracted, ears pendulous, sometimes tympanitic,

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but often tucked up, coat staring, temperature normal or slightly subnormal, navel sometimes puffy, at others quite dry and firm, and in a few hours death supervenes.

More than one case has been encountered where a calf has died within twelve hours of birth, and examination of the navel cord has revealed the presence of pus along this tract even at such an early date. Moreover, these calves were also showing the white, putrid-smelling diarrhœa associated with white scour. From this brief description of the observed symptoms it will be appreciated that in some cases it is hard to make a satisfactory distinction between the two diseases, especially in those cases which prove rapidly fatal.

(7) *Post-mortem Examinations.*—Up to the present detailed post-mortem examinations of calves have not been attempted. A small number have been seen, but owing to the delay which has occurred before opportunity to examine the animals was forthcoming, decomposition has prevented any really useful observations or bacteriological examinations being made. On the majority of farms no autopsies have been carried out. On the remainder odd animals have been casually examined by the local veterinary surgeon. Enteritis, peritonitis and various stages of pneumonia appear to be the most common findings. Inflammation of the navel cord, with or without abscess formation, appears to be very prevalent. This last condition is observed in many cases of apparently typical white scour with no obvious joint or navel infection.

(8) *Treatment.*—The lines of treatment adopted for the various conditions encountered are very numerous. One of the peculiarities of these diseases is that a certain line of treatment will prove of great value on certain farms. On the other hand, in a neighbouring herd, the calves of which appear to have exactly the same complaint, this same treatment has no beneficial result at all. Moreover, a particular drug or vaccine will perhaps be successful on a farm during one year, but in the following year, when the disease again appears, treatment by the same method is unsuccessful. One point appears definite. Any treatment which is to prove successful must be undertaken early. The best results are obtained on those farms where the diseases have previously prevailed, and where the owner begins to administer his most successful line of treatment before the disease appears. When once either of the diseases becomes firmly established treatment is in the great majority of cases of small value. In many cases of scour the symptoms are treated with such drugs as salol, bismuth, chlorodyne, hydrocyanic acid, tannofom, quinine, etc. These drugs meet with varying success. Frequently the diarrhœa is checked only as long as treatment continues. At other times the calves, although relieved from the symptoms, die as the result of a generalised infection.

Sera and vaccines of numerous kinds are on the market. In many instances their administration is encouraging, whilst in others, under apparently identical circumstances, the results are disappointing. The best results of such therapeutic treatments appear to be obtained when any of these methods are applied to calves

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on infected farms, immediately at birth, irrespective of whether they present any symptoms of disease. At the best the treatments of these diseases by such methods are very much of a "hit or miss" nature. It is suggested that as the diseases in question appear to be caused by a variety of organisms, probably complicated by secondary invaders, a mixed vaccine is the most likely to meet with any success. This must be administered as early as possible. Symptomatic treatment can be advantageously combined. A survey of the lines of treatment adopted on some of the farms included in this inquiry shows the following results :

Farm No. 1.—An ill-defined enteritis with persistent diarrhœa. All usual lines of treatment were adopted with no beneficial results. Twenty calves out of a total of thirty were affected when about three days old. All died within twenty-four hours.

Farm No. 2.—A white scour mixture of chalk and chlorodyne met with success in twenty-four out of thirty calves. The remaining six survived for up to three weeks before ultimately dying of exhaustion, the diarrhœa persisting.

Farm No. 3.—The above treatment effected a cure in only three calves out of a total of seventeen which were apparently affected with exactly the same condition as those on Farm No. 2.

Farm No. 4.—The owner of this farm found it impossible to differentiate between scour and navel ill, as several of his calves appeared to suffer from both conditions. The common internal antiseptics and astringents had no beneficial influence. However, decided success followed the administration of iodine given three times daily in the milk. The iodine was included in the first feed taken.

Farm No. 5.—The same experiences were encountered as on the previous farm. Iodine administered internally appeared to be the only drug which produce encouraging results.

Farm No. 6.—White scour prevailed on this farm. Vaccines were tried, but proved unsuccessful. A slightly better result was attained with internal antiseptics. Only 25 per cent. of the calves were saved.

Farm No. 7.—After several years, during which time calf losses were very great, the line of treatment ultimately adopted was a mixed vaccine given at birth. This was accompanied by a scour mixture given twice a day for one week. During the two seasons following these administrations the losses were greatly reduced.

Farm No. 8.—This farmer found that putting his calves on a diet of boiled milk and white of eggs, together with a very popular proprietary preparation, was the only treatment which proved successful. Vaccines and scour mixture, prepared by his own veterinary surgeon, had all been tried before the above treatment was adopted.

Farm No. 9.—Many treatments had been tried unsuccessfully. The calves invariably started with typical white scour. In many cases the navels were swollen, hot and painful. These symptoms were followed by an acute congestion

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of the lungs. The calves became very distressed, and died within four days of the onset of symptoms. For two years it was found impossible to rear a single calf born in the spring of the year. During the following winter this herd was cleared of all tuberculin reacting animals, and the entire premises were thoroughly disinfected. The trouble in the calves appears to have disappeared from this date. Prior to this time calves had been housed immediately after birth in all possible places, including the garage and even the dwelling-house, in order to try to avoid infection from contaminated premises.

Farm No. 10.—After trying a varied selection of remedies, this farmer administered a large dose of castor oil at birth, and kept the calves on a very low diet for several days. This line of treatment proved comparatively, but not completely, successful.

Farm No. 11.—Scour mixtures, whisky, sour milk, port wine and eggs, and innumerable "quack" medicines were tried by this farmer. He ultimately decided that the best results followed the administration of a mixed vaccine together with iodine internally.

The above instances, taken at random, are not quoted in order to recommend any particular treatment. They are mentioned to illustrate how, in this district at any rate, a wide variety of treatments have been tried with variable success. It is realied that in other parts of the country other methods depending on the individual fancies of practising veterinary surgeons are used, probably with similar results. The most successful line of treatment appears to be a mixed vaccine combined with internal antiseptics. It is possible that in many cases the veterinary surgeon is not completely clear as to the disease with which he is actually dealing. A calf at twenty-four to forty-eight hours old presents symptoms which make it extremely difficult, if not impossible, to decide whether one is dealing with a navel infection, with white scour, or with some other similar condition. Consequently empirical treatment has to be adopted, sometimes with success, at others with failure.

(9) *Treatment of Navels.*—It has been suggested that, as a precautionary measure, the navels of calves should be treated with some form of disinfection. The inquiry shows that on some farms such precautions were invariably adopted, but the disease was in no way checked. On others the navels were never treated, and the disease never seemed to occur. It was observed that out of the twenty-four farms affected with these diseases, the navels received no treatment on eleven, while on the remainder the navels were treated in various ways. In some instances the navels were tied, in others this was not the practice. Frequent applications of disinfectants were made on some farms, on others a single application was relied on. The agents used for this treatment were formalin, Jeyes' fluid, iodine and tar, in order of their frequency. On two farms where no disease occurred, no such precautions were taken. It seems reasonable to conclude that while treatment of the navel cord at birth and subsequently must tend to reduce

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the chances of infection through this channel, the beneficial results derived from this practice are not very great.

(10) *Conditions under which Calves are Reared.*—It has been suggested that predisposing factors play an important part in the occurrence of these diseases, and that cold, wet and dirty pens, together with insufficient nourishment, are conditions which render young calves easy victims of these conditions. Such obvious facts cannot be denied, but it seems possible that too much importance can be placed on them. For instance, it is quite common to find calves kept in such bad conditions absolutely free from the diseases under consideration. Conversely, calves reared under the very best conditions are often seriously affected. Out of twenty-four herds affected with one or other of these diseases, the conditions under which calves were kept were excellent in ten cases. In ten other instances the conditions were quite good, and no blame could be reasonably attached to them. Only in four cases were the calves found to be living under bad hygienic conditions. These four farms were by no means the worst sufferers. Frequently owners have made special efforts to ensure clean, warm and comfortable accommodation for their calves. In the majority of such cases where the disease was prevalent these precautions have provided no evidence that they appreciably lessened either the incidence or severity of these calf diseases. It cannot be claimed that the keeping of calves in unsatisfactory surroundings is essentially associated with the occurrence of these particular infections.

(11) *Disinfection of Premises.*—Preventive measures are said to be of greater value than curative ones when combating these infections. The thorough disinfection of premises, especially those used for calves, is held to be one of the most important precautions. It is, therefore, disconcerting to find that in many cases the diseases appear to flourish in spite of the most thorough disinfection of all walls, floors and utensils. It is, in fact, very unusual to find a case where disinfection of premises has shown any conclusive benefit. It is the usual practice that pens used for calves in the spring are cleaned out and used for stores, etc., in the summer. They are then thoroughly disinfected before calves are again put into them the following autumn. Moreover, cases have been encountered where in order to try to avoid any infection from such outside sources, the calves have been carried direct to and kept in such places as horse boxes, garages, haysheds, and even the dwelling-houses, and still the diseases developed.

In the present series only on three infected farms was disinfection not regularly practised. On the remainder the premises were disinfected at intervals varying from each day, each week, and in most twice a year. On two farms where there was no infection, disinfection was not carried out. No one would deny the general benefits of disinfecting premises. On the other hand, no reliance can presumably be placed on the adoption of such measures to prevent the occurrence of either of these diseases. Another suggested source of infection is the teats of the cow. In Ayrshire it is, however, extremely rare to find a herd were the cow is suckled by its calf. Moreover, before the cows are milked it is the regular practice to wash the udders and teats.

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(12) *Frequency of Outbreaks.*—The result of this inquiry shows that outbreaks on individual farms can occur consecutively for a varying number of years. In some instances there will be very heavy losses for several years. These losses will subside, gradually or suddenly, and the diseases will be absent for a long period. They will then unaccountably reappear and remain active for a similar varying period. In other instances a farm is troubled with a relatively constant mortality in the calves from these diseases for years without a break. Sometimes these losses are light, sometimes they are heavy. The premises never seem, however, to be entirely free from infection.

(13) *Introduction of Infection.*—Many infectious diseases are undoubtedly introduced into herds through purchasing animals from other herds, or from markets. There is little doubt but that scour or navel-ill could be so introduced. It cannot be claimed, however, that these are important sources of infection in the district investigated. Over 90 per cent. of the herds in Ayrshire are self-supporting, and the purchase of calves is largely confined to an occasional bull for stud purposes. During the period covered by this inquiry there was no single instance of a newly-purchased calf being affected. This was due to the fact that throughout this time only three calves in the twenty-six herds changed hands. These were three healthy bull calves. An attempt to show that either of these diseases was transmitted from herd to herd through the movement of stock thus proved negative.

(14) *Contagious Abortion.*—Although the theory is not generally accepted, it has been suggested that the presence of contagious abortion in a herd may have some predisposing influence on the incidence of these diseases. From the present inquiry it appears that this is extremely unlikely. There was no instance of any correlation between the two conditions.

(15) *Mastitis.*—In the same way it appeared desirable to investigate any possible association between mastitis in the cows and disease in the calves. There did exist cases where mastitis and scour or navel-ill were both prevalent on the same farm. There were, however, many more farms on which one or other of the conditions existed alone. Briefly, it was not possible to associate mastitis in the milch animals with either scour or navel-ill in their progeny.

(16) *General Conditions of Cows at Time of Calving.*—Inquiries were made into the general health of the cows at the time of calving on farms where the diseases prevailed. Such conditions as retained fœtal membranes, vaginal discharges, and second cleansings were considered. It was, however, impossible to establish any correlation between any such conditions in the dams with infection in their calves.

(17) *Dietetic Influences.*—It seemed possible that at least one of these calf diseases, namely, scour, might be influenced by dietetic conditions. These were therefore investigated, with the following results :

(*a*) *Effect of Calf Being Allowed to Suck its Dam.*—Out of the twenty-four farms where disease existed, only on one farm was it the practice to allow calves to suck their dams. On two other farms some calves were allowed to suckle

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as an experiment, which, incidentally, had no beneficial effect. On the remaining farms the calves were never allowed to suck their dams. This latter practice also prevailed on the two farms which were entirely free from infection.

(*b*) *Effect of Calves Receiving the First Milk from the Dam.*—It is well known that the colostrum exerts a mild laxative action on the suckling. It is also held that this first milk is responsible for certain antigenic activities which act favourably against bacterial infections in the young animals. It does not appear, however, that this action is sufficient to produce any real defence against either of these calf diseases. It is the practice in the majority of the herds in this district to allow calves to receive the first milk from its dam. In only two cases in the series did the calves not receive this milk, and on one of these farms there had been no disease for ten years. On three other badly infected farms some calves were allowed to receive this milk, others were not. No noticeable difference was observed, however, in the incidence of calf diseases. In all other cases the colostrum was given to the calves.

(*c*) *Effect of Feeding Own Dam's Milk.*—In nineteen cases the calves were fed for varying periods of from two days to a month on their own dam's milk. In five cases the dam's own milk was not given. On two farms this milk was sometimes given and sometimes not.

(*d*) *Manner in which Milk was given.*—A great quantity of literature is available giving divided opinions concerning the properties of raw milk as against the pasteurised or boiled article. Recently McCandlish and Black (1932) undertook an experiment which they state indicated that calves fed on pasteurised milk were more susceptible to disease than those fed wholly on raw milk. The present survey shows that calf diseases are extremely common on farms where nothing but raw milk is fed. The practice of feeding calves on pasteurised milk is unheard of in this district, and no case has actually been encountered where boiled milk was normally fed to calves. It is the universal practice to feed the calves on raw milk with in many cases the addition of a slight dilution of warm water.

The only results of this dietetic inquiry are of a negative character. Allowing cows to suckle their calves appears to have no beneficial result, nor does the fact that the calves receive the colostrum from their dams. No comparison can be made between calves fed on raw or heated milk, as none fed on the latter were ever encountered. It seems, however, that the mere fact of the milk being raw exerts no favourable influence.

Discussion.

It is well established that the numerous organisms associated with either scour or navel-ill are ubiquitous. It would seem that they are constant inhabitants of the intestines of healthy animals. An examination of literature does not reveal any recent systematic investigations carried out on a considerable number of calves suffering from the diseases being considered. White scour appears to be chiefly due to an infection with one of the strains of bacillus *Coli communis*. Other organisms are stated (Hutyra and Marek, 1920) to be sometimes demonstrable, *e.g.*, *Bacillus*

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aerogenes, *Paracolon bacilli*, *Bacillus pyocyaneus*, etc. On the other hand, navel- or joint-ill appears to be more closely associated with such organisms as the staphylococcus *Pyogenes aureus*, streptococcus *Pyogenes*, the bacillus *Bipolaris septicus*, and again, bacteria of the bacillus *Coli communis* type. These diseases are commonly fatal within a very short time after birth. On certain farms conditions appear favourable for infection to occur, and yet these diseases do not prevail. On others every attempt is made to reduce the possibility of infection to a minimum, and yet the diseases are prevalent. It appears certain that many calves are exposed to heavy infection, and do not contract either of these diseases. It seems reasonable to inquire whether the invasion of any one of the above-mentioned organisms might be associated with some lack of tone or lowered resistance on the part of the susceptible mucous membrane of the alimentary tract of calves, or be associated with a lessening of resistance to general infection. The theory has been advanced that there is some unknown predisposing factor which in some instances results in calves becoming not only infected with, but affected by, the invasion of these organisms.

Incorrect feeding combined with a heavy oral or navel infection with such organisms may prove a sufficient explanation for an infection. These factors could not, however, satisfactorily explain the many cases where calves show clinical symptoms, or are even found dead within twenty-four hours of birth. According to Joest (1903) the great susceptibility of calves which have not yet taken any food may be explained by the fact that the colon bacilli, which enter the stomach before the ingestion of the colostral milk, pass without interference into the small intestines, as the stomach has not yet produced any gastric juice. Owing to the absence of the intestinal juices the meconium which is present in the intestines affords a favourable medium for the multiplication of the bacteria. Their penetration into the mucous membrane is probably also facilitated by the fact that the intestinal epithelium does not at that period possess a mucous covering, and is therefore easily penetrated. However true this may be, it does not explain those cases where the channel of infection appears to be through the navel. Many factors which may influence the onset of these diseases have already been dealt with under the previous headings. None of them offers any solution to the problem. The conditions to which calves are subjected, from the time of birth up to a period when the diseases do not appear to affect the calves, have been examined, and no correlation has been discovered between any of them and evidence of the disease. It seems possible, therefore, that if a predisposing factor is operating, this occurs while the calf is *in utero*. This would account for the very early infection which is shown when calves becomes clinically affected within a few hours after birth.

During the present inquiry one very striking fact was noted: It was found that these diseases had a definite seasonal occurrence. They began about the middle of February and became progressively more prevalent as the season advanced, until the end of April. From then until the end of October the diseases

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seemed to disappear. There was a further, but much milder, outbreak during the early part of November. The significant point is that the diseases almost entirely disappeared when once the cows were put out to pasture, and did not reappear until they were brought in again in the autumn. It was realised that the significance of this observation might be questioned on the ground that a comparatively small number of cows were calving whilst out at grass. Due consideration has been given to this fact, but the conclusion remains unaltered. The calves born of these grazing cows are born indoors, and are subjected to the same environment as those born earlier in the year. This factor is so striking, and so generally accepted in this district, that some farmers arrange that their cows shall calve later in the year in order to avoid loss of calves. It cannot be stated that scour or navel-ill is unheard of during the summer months, but cases are extremely rare, and when they do occur they are isolated ones. The definite seasonal trend in the incidence of the calf diseases noted above, and the fact that the prevalence of these diseases falls to negligible proportions when the calving cows are at grass, gives ground for the belief that a nutritional deficiency in the maternal diet may be a predisposing factor in their ætiology.

The proximate constituents of a cow's winter diet (*i.e.* proteins, fats and minerals) are essentially the same as those which are present in the diet which she receives when at grass. There is, however, one important difference during the winter and early spring months. The cow's diet is comparatively low in vitamin content. Moreover, it seems that the highest incidence of calf diseases is experienced in those herds where the cows are heavily fed on concentrates, and milked up to their maximum yield all through the winter. Herds receiving larger amounts of roots and hay, and consequently producing less milk per cow, seem to be less seriously affected. Should these diseases prove to be associated with an avitaminosis in the cows, one would expect that the spring calves from heavy milking animals would be more susceptible, as their dams would have used up more of their available vitamin stores during winter milk production. If an avitaminosis is in fact associated with the incidence of calf diseases, it is likely to be due to an absence of vitamin A rather than of any of the other vitamins. There seems no room for doubt that a diet deficient in vitamin A does predispose to bacterial infection.

Green and Mellanby (1928, 2) found that rats receiving a diet deficient in vitamin A almost invariably died with multiple infective foci. The seats of these foci were : tongue, lungs, uro-genital tract, middle ear, prostate glands, seminal vesicles, spleen, ovaries and intestine. The administration of vitamin A to the diet of a control group of fifty rats fed on the same diet resulted in an absence of infection among these animals. Green and Mellanby therefore gave the name of " anti-infective vitamin " to vitamin A to signify that animals deprived of this substance died of bacterial infective lesions.

The question of the relation of diet to infection of the intestine has also been considered by Cramer (1923). Lassen (1930) has found that rats inoculated orally

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or subcutaneously with paratyphoid bacilli succumb more readily when the diet is deficient in vitamin A than when rich in this substance. It is claimed by Cramer and Kingsbury (1924) that a deficiency of vitamin A in the body simply brings about a breakdown of the local defences of such organs as the intestine, eyes, and lungs, against bacterial invasion, and has no effect on the general humoral defences. There appear, therefore, to be some grounds for relating the incidence of the two calf diseases, white scour and navel-ill, to a lack of vitamin A in the maternal diet during the later months of pregnancy. It must, however, be clearly understood that no attempt has been made to urge that any such avitaminosis is the fundamental cause of either of the calf diseases described. Such a factor could only act as a predisposing agent. Experiments are at present in progress to explore this suggestion.

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THE SCIENTIFIC PRINCIPLES OF DAIRY COW FEEDING.

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AMONG farm animals the dairy cow stands unequalled as a producer of human food. She converts products which are most inedible for man into an inestimable human food more economically than any other class of animals. To show this economic superiority in a striking manner, we may mention that Eckles reports that a high-producing cow produced in a year enough protein to build the bodies of three two-year-old steers ; fat sufficient for nearly two ; and mineral matter enough for three ; besides 920 pounds of milk sugar, which is as nutritious, or even more, as the same weight of cane sugar. This example can be easily doubled in case of cows of average production. Knowing this, one may wonder about the ways a dairy cow utilises her ration. The latter is used for five main purposes, namely, maintenance, growth, body fat, development of fœtus, and milk production. The maintenance ration must be considered somewhat as a necessary

overhead expense. Apparently none of it, except perhaps some of the protein, contributes anything toward economic production, yet as a general rule it is the first to be used by the cow, and certainly should be the first to be considered in compounding a ration. A dairy cow in full flow of milk needs nearly half the nutrients in the feed she consumes merely for maintaining her body. An immature animal uses parts of its feed for growth. The ration for growth requires somewhat more protein than does the maintenance ration. The feed needed for body fat is of no considerable consequence, except during the time when the cow is dry, or nearly so: at this time she is storing up a reserve to be used after calving.

When the cow is carrying a calf she needs extra feed to provide for the development of the fœtus and the membranes and fluids co-existent with pregnancy. The quantity of feed required for these purposes is not large, but is sufficient to be considered. Just after calving, and for three to six weeks thereafter, high producers do not consume sufficient feed to supply the nutrients needed for milk and for maintenance, and as a result they lose weight. Liberal feeding is desirable, but only to the point of supplying the nutrients they can use without undue waste.

Nutrients required for Milk Production.—(1) Proteins in the feed are used to make the proteins of milk, blood, lean meat, and all nitrogenous body tissues. Although it is unanimously conceded that dairy cows require more protein than do fattening animals or work horses, authorities differ somewhat as to the exact amounts of protein advisable. While Savage recommends that dairy cows be fed rations having nutritive ratio no wider than about 1 : 6, Haecker concludes from his trials that rations having a nutritive ratio of about 1 : 7 were as satisfactory as those furnishing more protein. However, it has been experimentally proved that protein is a cell stimulant, and that a supply somewhat above the minimum promotes the well-being of the animal. From trials of Lindsey, one may conclude that feeding an excess of protein over the actual amount required for body maintenance and milk production tends to stimulate the cow to a greater yield of milk. In one test, supplying twice the minimum amount of protein required increased the milk flow 15 per cent. While the yield of milk may be thus increased by feeding an excess of protein, Lindsey concludes from eight trials that varying amounts of protein do not seem to influence the percentage composition of the milk—making it richer or poorer in fat, for example. On the other hand, other authors have found increase of the fat content of the milk with a ration having a such narrow ratio as 1 : 4.

Not only the quantity of proteins is important in milk production, but also the quality. The dairy cow must receive proteins furnishing a well-balanced supply of amino acids. Hart and Humphrey have found in recent metabolism experiments with dairy cows that proteins from various sources may sometimes be of different worth for milk production. When fed with corn stover as the only roughage, protein from gluten feed, or from the entire corn or wheat grains (much of which is unbalanced in composition), was distinctly inferior to milk

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protein or to the protein of linseed meal or distillers' dried grains. However, with clover hay and corn silage as the roughages, there was little difference in the efficiency of the different sources of protein. From these trials we may conclude that in the mixed rations in which silage and legume hay are combined with grains, there is little difference in the efficiency of the proteins furnished by the various protein-rich supplements. Therefore it is advisable to use concentrate mixtures made up of a reasonable variety of feeds rather than using only two concentrates in the ration.

Minerals needed by Dairy Cows.—The most important salts are those of calcium and phosphorus. Forbes has shown that high-producing cows lose calcium, phosphorus, and also magnesium from their bodies, in spite of having such excellent winter rations as alfalfa (lucerne) or clover hay, corn silage, and corn with such high-protein concentrates, in addition, as wheat bran, cottonseed meal, linseed meal, dried distillers' grains, or gluten feed. They were apparently able to assimilate and retain so small a portion of the liberal supply in their feed that it was insufficient to meet the requirements in producing the milk. Addition of mineral supplements did not change the results. From this and many experiments it has been concluded that it is difficult to keep these animals in calcium equilibrium when they are giving more than five kilograms of milk daily.

The extensive experiments of Steenbock, Hart and co-workers have shown that the inclusion of fresh green plant materials in the diet had a highly favourable influence on the rate at which this element was assimilated. According to these investigators, calcium is very poorly assimilated from rations composed of concentrates, timothy hay and corn silage, even though the calcium content of such rations may be made quite high by the addition of large quantities of bone meal. From rations composed of concentrates, alfalfa hay and corn silage, but without bone meal, on the other hand, the calcium assimilation is much better, and particularly if the hay used is cured without too long exposure to direct sunlight. Finally, the assimilation of calcium from rations composed of concentrates, fresh green alfalfa and corn silage, is decidedly better than from rations containing the best kind of alfalfa hay.

In 1925, Meigs and co-workers drew the conclusion that " calcium assimilation is facilitated when there is present in the rations a vitamin which is contained in fresh green plant material, and particularly in the green alfalfa plant. The vitamin in question is destroyed to some extent when the plant material is dried, even under the most favourable conditions. Long exposure to the sun increases the extent to which the vitamin is destroyed, but alfalfa hay which has been exposed in windows for four days to direct sunlight still contains fairly large amounts of it." They obviously refer to vitamin D. Turner, Harding and Hartman, carrying out metabolism experiments involving the use of rations where the content of phosphorus was increased by the addition of sodium phosphate, suggest a better assimilation of calcium and phosphorus when the value of the Ca/P of the feed is 1.25 than when it is 2.5.

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Hart, Steenbock and Bohstedt state that " whenever we have had 20–25 per cent. of wheat bran in the ration of dairy cows, the phosphorus needs have been met even with cows milking fifty to sixty pounds of milk daily." These various experiments show that a liberal supply of pasture or other green feed, well-cured legume hay, or even mineral supplements (steamed bone meal, bone ash, etc.), is necessary for continued high milk production, not only in the period of high production, but also later on in lactation and when the cows are dry. Common salt should also be regularly supplied. Pregnant cows may be advantageously supplied with iodised salt at the rate of two ounces of salt per individual per day to secure protection from goitre for their offspring.

Vitamins needed by Dairy Cows.—The relation of vitamins and milk production is not so important a problem, because the usual type of balanced ration recommended for dairy cows will furnish an ample supply of vitamins for the health of the cows, with the possible exception, just pointed out, of the antirachitic vitamin, which aids in calcium metabolism. An interesting piece of work was done recently by Steenbock, Hart and co-workers, in which it was proved that direct exposure of a goat to the radiations of a quartz mercury vapour lamp increased the anti-rachitic value of its milk very decidedly. This was in direct contrast to the results with cows whose milk was not significantly increased in its anti-rachitic potency, in spite of daily exposure of the cows to sunlight or artificially generated ultra-violet radiations. Furthermore, they observed in the case of goats that these irradiated animals showed a very decided negative calcium balance, although originally with the beginning of irradiation a slight improvement in calcium retention resulted. They arrived at the conclusion that anti-rachitic activation, therefore, cannot be considered a panacea for a disturbed calcium metabolism. The anti-scorbutic vitamin is increased in milk solely through feeding green plants. The udder has no power of forming these vitamins that are now recognised as so important in proper nutrition : these substances are secured from the supplies in the feed and concentrated by the cow in her milk.

Feeding Standards for Dairy Cows.—As the result of long years of careful study with a high-producing dairy herd, Haecker made an important advance in the formulation of ration for the dairy cow. He was the first to show that the nutrients required for her nourishment should vary not only with the quantity of milk yielded, as was taught in the Wolff-Lehmann, the Kellner, and the feed-unit standards, but also with the quantity of the product, *i.e.* with the milk-fat content. Accordingly, he puts his standards for feeding dairy cows. Then Savage, of Cornell University, concluded from his trials that for maximum production the nutritive ratio of rations for dairy cows should not be wider than 1 : 6. He has accordingly modified the Haecker standard by increasing the protein requirement per pound of milk by from 18 to 20 per cent. Both standards are hereafter shown in the following table :

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Feeding Standards for Dairy Cows Compared.

	Haecker Standard		Savage Standard	
	Digestible crude protein lb.	Total digestible nutrients lb.	Digestible crude protein lb.	Total digestible nutrients lb.
For maintenance of 1000-lb. cow	0.700	7.925	0.700	7.925
To allowance for maintenance add to each lb. milk				
2.5 per cent.	0.045	0.254	0.053	0.257
3 per cent.	0.047	0.284	0.057	0.287
3.5 per cent.	0.049	0.313	0.061	0.319
4 per cent.	0.054	0.343	0.065	0.350
4.5 per cent.	0.057	0.372	0.069	0.379
5 per cent.	0.060	0.398	0.073	0.405
5.5 per cent.	0.064	0.424	0.077	0.431
6 per cent.	0.067	0.451	0.081	0.457
6.5 per cent.	0.072	0.480	0.085	0.484
7 per cent.	0.074	0.502	0.089	0.508

The Haecker and Savage standards agree in the requirements for maintenance. Savage digestible crude protein requirement for production is higher in each case. In total digestible nutrients he agrees very closely with Haecker.

There are other feeding standards, formulated by various workers like Armsby, Eckles, Hansson, etc., but these are either expressed on the net energy or feed-unit basis. The first type is not so practical to apply because the net energy values actually determined are for but a few feeds, and with these only for the fattening ox. For other feeds and other classes of animals the values which may be computed are but approximations. The latter type of standards did not, as previously pointed out, take the fat content of milk into consideration. On the other hand, during the last half century scores of thousands of analyses of feeding stuffs have been made and large numbers of digestion experiments have been conducted in which the co-efficients of digestibility have been determined. Thus both the Savage and Haecker standards are based on a reasonably secure basis.

From many trials it has been concluded that it is necessary to feed dairy cows as much concentrates as are required to meet the recommendations of the Savage production. It is also economy to feed a liberal concentrate allowance when concentrates are relatively low in price compared with hay and other roughage. The so-called Morrison standards for dairy cow feeding are practically those of Haecker and Savage combined in one table. For this and that reason, Savage standards are to my mind superior to other standards, and are going to be taken here as a basis for computing dairy cow ration.

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Figuring Rations for Dairy Cows.—In order to figure out rations for dairy cows or any other class of stock, it is first necessary to know the amounts of various nutrients they require. This information is given in the above table. For cows in milk the amounts of nutrients required for producing the given weight of milk must be added to the amounts required for maintenance. To find the total requirements of any cow, first compute the requirements for maintaining a cow of that weight. Then figure out the requirements for producing the amount of milk she yields, and add these requirements together. For example, let us suppose that the average cow in a dairyman's herd weighs 1,200 lb, and yields daily 30 lb. of 3.5 per cent. milk. The table shows that for maintenance, this 1,200-lb. cow will require 0.84 lb. digestible crude protein and 9.51 pounds total digestible nutrients. From the table one may readily calculate that 30 lb. of 3.5 per cent. milk will require 1.83 lb. of digestible crude protein, and 9.48 lb of total digestible nutrients. To get the total requirements, merely add together the requirements for maintenance and for milk production. The result will be 2.67 lb. digestible crude protein, and 18.99 lb. total digestible nutrients. Now let us figure out a good ration for the cows in the herd of the dairyman we have previously mentioned. For a trial ration one may follow a certain thumb-rule of feeding, which gives one pound of red-clover hay to three pounds of corn silage for each 100 lb. the cow weighs. This will make 12 lb. of clover hay and 36 lb. of corn silage. To this allowance of roughage we shall add enough corn, which is the cheapest source of nutrients among the concentrates, to bring the total digestible nutrients up to the amount advised in the standard. This will take eight pounds of corn. The first trial ration meets the requirements in total digestible nutrients, but it is very unbalanced, for it furnishes only 1.91 lb. of digestible crude protein, while the standard calls for 2.67. We should, therefore, substitute protein-rich concentrates for part of the corn. As it is also desirable to have a bulky ration, we have to add something like wheat bran, lucerne meal, and possibly dried brewers' grains. Wheat bran is the most economical, rich in phosphorus, good conditioner, and palatable. It serves to lighten the concentrates employed. A little figuring, with the help of the feed composition tables, leads us to give the following: clover hay, 12 lb.; corn silage, 36 lb.; corn, 4 lb.; wheat bran 2 lb.; cottonseed meal, 2 lb.; This ration will give us 2.60 digestible crude protein, and 18.69 lb. total digestible nutrients. It can be considered a reasonably satisfactory ration for a 1,200-lb. cow producing 30 lb. of 3.5 per cent. milk daily.

As the feeding standards do not take mineral requirements into consideration, we should supply the dairy cow, especially the heavy producers, with ample amounts of calcium and phosphorus in the form of bone meal, ground rock phosphate, limestone, marl, etc. If poor roughage must be used, such as hay from the grasses (not legumes), corn stover grown on acid soil, or straw, add three to four pounds of ground limestone, wood ashes, dried marl, or thoroughly air-slaked lime to each 100 pounds of concentrate or grain mixture. If there is not 20 per cent.

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of high phosphorus feeds in the concentrate mixture (wheat bran, wheat middlings, linseed meal, and cottonseed meal), it is best to use three to four pounds of steamed bone meal, ground rock phosphate, or acid phosphate with each 100 pounds of the concentrate mixture instead of using the limestone, wood ashes, or marl. Bone meal and the phosphates supply both calcium and phosphorus, while limestone, wood ashes, and marl furnish lime, but practically no phosphorus. Even with legume hay (already rich in calcium) it can do no harm, and may do considerable good to add one of these lime carriers to the ration. As to common salt, a good plan to follow is to mix one pound of salt with each 100 pounds of concentrates, and then in addition supply salt so the cow can have free access to it. Salt is cheap. Do not neglect supplying plenty of it. The water supply should be automatically continuous, if not, the daily consumption of milch cows ranges between twenty-two to twenty-five gallons, according to the production.

In conclusion, it should be remembered that in order to secure best results the feeder must exercise his best judgment, and make some variations to suit the individuality of each individual cow. This variation may be in adding or substituting a little linseed meal to condition a cow, or to stimulate more milk production. Again, it may be in adding corn meal or barley meal to the ration to improve the condition of the cow and prevent a tendency on her part to become too thin in flesh. It is well to remember that the eye and judgment of the feeder are all-important in dairying.

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ANÆSTHESIA IN CATTLE.

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FOR the last twenty years I have used chloroform anæsthesia in cattle, principally in dystokia and eversion of the uterus. In certain cases of dystokia, especially breech presentation, and in eversion of the uterus, it saves a great deal of hard

work, injury to the animal, and prevents shock, notably in eversion of the uterus. I have never had any bad results, which seems remarkable, as owing to the urgency of the case no fasting can be carried out. Again, the position in which the patient must be placed to facilitate the return of an everted uterus or the manipulation of a breech presentation seems to add considerably to the danger, as there is always the risk of regurgitation of food and consequent inhalation resulting in septic pneumonia. Another danger is the pressure of the abdominal organs on the diaphragm, which must be considerable, as the higher the hind quarters are, the easier it is to rectify a badly placed fœtus or to return an everted uterus. In spite of all these dangers, as I said before, I have never had death ensuing from anæsthesia in such cases.

I use a Cox's mask, and have maintained anæsthesia for varying periods up to three hours in difficult cases. I start with two ounces of chloroform, and give it slowly, increasing the dose as necessary. Eight ounces can be given with safety. Bovines seem to take the chloroform very well, in fact much better than the average equine. After anæsthesia is induced the further administration can be left to a layman, provided he has been given definite instructions as to procedure.

Owing to the frequency with which eversion of the uterus takes place in conjunction with parturient apoplexy, great care must be taken to make as certain as possible that no milk fever is present before administering the chloroform, as an animal so affected very often succumbs from the combination of milk fever and shock produced by the eversion of the uterus. In cases where there is an element of doubt it is advisable to inject calcium, and proceed with removal of any placentæ still adhering to the organ and a general cleaning up and preparation for its return, such as fixing up of block and tackle, preparation of bales or sacks of hay or straw on which to rest the hindquarters, etc. By the time everything is ready it will be quite easy to decide whether it would be safe to carry out anæsthesia or not.

With regard to spinal anæsthesia, it has been claimed by some authorities that this is much the safest method to use in dystokia and replacing an everted uterus. I have used this in many cases with good effects, but can see no reason why I should drop the use of chloroform considering the results obtained. In repelling a fœtus, I have found it beneficial to inject the anæsthetic after the animal has been elevated, as then one gets diffusion up the canal of the agent used, and therefore a greater area anæsthetised. In cases where milk fever is present it is not necessary to use any type of anæsthetic, either general or spinal, unless the animal is suffering from the " wild " type, when a spinal would be beneficial, as the narcosis induced by the milk fever is sufficient to lessen the straining or labour pains enough to simplify the operation. If a spinal anæsthetic has been used in a case complicated by milk fever, and the cow remains recumbent afterwards, which unfortunately is a very common sequel of milk fever, the owner is inclined to blame the spinal injection. While on the subject of milk fever I would like to say that I have had equally as good results from the subcutaneous injection

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of calcium as from the inflation of the udder, provided regular massage is carried out by the attendant. The dealing and dairying fraternity in this district much prefer it, as a cow can go into the sale ring two days after treatment, and does not take so long to attain her normal milk yield.

THE IDENTIFICATION OF *B. OVITOXICUS* TYPE OF TOXIN FROM THE INTESTINE OF SHEEP IN GREAT BRITAIN.

BY

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THE object of this note is to record the finding of a toxin resembling that produced by *B. ovitoxicus* (Bennetts) in the intestine of lambs and ewes in Britain. During investigations at the Veterinary Laboratory, University College of North Wales, into "pulpy kidney" in lambs, and the cause of sudden deaths ("strike") in ewes in spring, there has been demonstrated in the intestine of sheep dead of these diseases the presence of a toxin fatal to mice, lambs and ewes when injected intravenously. A sterile filtrate of saline diluted intestinal contents is prepared, and if it proves lethal to mice, anti-sera of different types are mixed with it; the result of the injection of the mixtures into mice determines broadly the type of toxin present in the filtrate. This procedure has been used at the University College in the diagnosis of lamb dysentery, and until recently the general result was that lamb dysentery serum protected against the toxin in the intestine of typical lamb dysentery cases, but failed to have any effect on the filtrates of typical "pulpy kidney" and "strike" cases.

Recently different types of anti-serum have been available for this work. (Bennetts kindly supplied some *B. ovitoxicus* anti-serum made by him in Australia, and Oxer provided serum of a similar type made in Tasmania; the Wellcome Laboratories supplied several batches of lamb dysentery anti-serum as well as some anti-serum made from a culture of *B. ovitoxicus* sent to them by Bennetts, and some anti-serum made from a culture of the "D" strain of *B. welchii* supplied by Wilsdon.) The results of the use of such sera have shown that *B. ovitoxicus* anti-serum has regularly neutralised the toxic element in the filtrates from "pulpy kidney" and "strike" cases, while in some lamb dysentery cases a similar result has been obtained. A further finding was that the one available batch of lamb dysentery anti-serum prepared at the Wellcome Laboratories prior to 1930 behaved as did *B. ovitoxicus* anti-serum, protecting mice against these toxic filtrates as well as protecting against filtrates prepared from lamb dysentery cases, and not neutralised by *B. ovitoxicus* anti-serum. However, more recently produced batches of lamb dysentery anti-serum failed to afford protection where *B. ovitoxicus* anti-serum did. It has also been shown that the anti-serum made

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from the Wilsdon " D " culture behaved as did *B. ovitoxicus* anti-serum and the old batch of lamb dysentery serum when mixed with filtrates from " pulpy kidney," " strike," and certain lamb dysentery cases.

From this work, therefore, it may be concluded briefly that there is evidence of the existence of toxin in the intestine of lambs dead of " pulpy kidney," ewes dead of " strike " and lambs dead of lamb dysentery. With the exception of the toxin from some of the lamb dysentery cases this toxin is neutralised by *B. ovitoxicus* and the Wilsdon " D " anti-sera. The old batch of lamb dysentery anti-serum possesses the same property, while more recently made batches fail to show such protective qualities, though they are, of course, fully protective against true lamb dysentery (agni) infection. In the exceptional cases of lamb dysentery, both the old and new batches of lamb dysentery anti-serum protected, and *B. ovitoxicus* and the Wilsdon " D " anti-serum failed. A paper will be published at an early date by Montgomerie and Rowlands dealing fully with their findings in connection with these diseases in North Wales.

At the Wellcome Laboratories a detailed study of the toxins produced by the various organisms of the *B. Welchii* group (especially the lamb dysentery (agni) type, *B. paludis* and Wilsdon " D " type), based chiefly on the types of anti-toxins produced under various conditions, has been in progress for some time, and a paper on the subject by Glenny, Barr, Jones, Dalling and Ross, is now in the press. These authors permit us to say that they have found that the filtrates of a single strain of the lamb dysentery (agni) type of organism contain a number of toxins with different properties, and that the serum prepared from such filtrates contains the specific anti-toxins in different proportions. Since writing the above-mentioned paper they have found that at least two toxins produced by *B. ovitoxicus* (Bennetts) are the same as those produced by cultures of the Wilsdon type " D," but sufficient work is not yet done to establish whether these two strains of organisms are identical. They have also shown that lamb dysentery serum as usually prepared at the Wellcome Laboratories contained anti-toxin to one of the toxins common to both *B. ovitoxicus* and Wilsdon " D." Filtrates made from the lamb dysentery types of Bacillus and *B. paludis*, have of late, however, failed to show this type of toxin, and recently prepared sera do not contain the corresponding anti-toxin. The explanation of this curious discrepancy is under investigation.

Summary.

(1) Filtrates of the intestinal contents of lambs dead of " pulpy kidney " and of ewes dead of " strike " contain a toxin which is lethal to mice and sheep when injected intravenously, and which is neutralised by anti-sera of *B. ovitoxicus* (Bennetts) and *B. Welchii* (Wilsdon type " D "). (2) This toxin is neutralised by a batch of lamb dysentery serum produced prior to 1930, but not by batches of subsequent production. (3) In the intestine of some lambs presenting clinical appearances of lamb dysentery a similar toxin has been found, whereas in other apparently similar cases a toxin is present which is neutralised only by lamb dysentery serum, all batches. (4) *B. ovitoxicus* and *B. welchii* (Wilsdon type " D ") are at the least closely related.

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B. WELCHII, THE "LAMB DYSENTERY BACILLUS," AND B. PALUDIS: AN EXAMINATION OF SINGLE-CELL CULTURES.

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Introduction.

DALLING (1928) recorded the morphological, cultural and toxin-producing properties of a *B. welchii*-like anaerobe, and compared it in some detail with *B. welchii*. The non-committal name of the "lamb dysentery bacillus" was assigned to it. McEwen (1930) described a similar organism which had many characteristics in common with the "lamb dysentery bacillus." Mason, Ross and Dalling (1931) compared Dalling's and McEwen's bacilli, and concluded that their toxins were the same. Recently Wilsdon (1931) investigated the cultural and toxico-serological properties of a series of *B. welchii*-like anaerobes; his findings were that, serologically, the toxins could be divided up into four groups.

Whilst employed at the Wellcome Physiological Research Laboratories, the author employed all means and methods at his disposal to show that the "lamb dysentery bacillus" was a mixture of two or more anaerobes. So-called purified cultures produced the same cultural and serological reactions as the original. Further, cultures purified by other workers behaved in exactly the same manner. There was, therefore, considerable justification for considering that the organism was in a state of purity. However, to control the problem, single bacterial cells were isolated (at Onderstepoort), and an examination both of the original culture and of that resulting from the single cell was carried out. A *B. paludis* and a *B. welchii* strain were included. It is proposed in this paper to discuss the morphological, cultural and toxico-serological properties of both the original and the single-cell cultures of these three germs.

Origin of Strains.

Lamb Dysentery Bacillus.—A sub-culture of the original, isolated by Dalling in 1923. *B. paludis.*—A sub-culture of the strain, labelled "CT 40," received from McEwen in 1930, and reported on in the article by Mason, Ross and Dalling. *B. welchii.*—A national collection of type cultures strain (SR 12).

Methods.

Fluid medium was, in nearly all instances, Robertson's meat broth; for surface cultivation, meat (horse) infusion peptone agar, plus 10 per cent. of a mixture of equal parts of sheep serum and sheep hæmolysed red cells (Mason, 1930), was used. "Sugar" solutions (for fermentation reactions) were dissolved in amounts of 1 per cent. in 1 per cent. peptone water, and sterilised by steaming on three consecutive days. The inoculated carbohydrate solutions were incubated for one month at 37° C. before readings were made, a McIntosh and Fildes' jar being employed to produce anaerobiosis.

In the isolation of the single organisms a Zeiss micro-manipulator was used. Of the methods tried, Fortner's (1929) micro-plate technique gave the most satisfactory results. In brief, a thin film of hæmolysed-cells serum-agar was made on a cover-slip, and after depositing a droplet of young culture at one end of this, the slip was inverted over a moist chamber. This was placed on the stage of a microscope and the drop focussed, using a Zeiss ocular 5 and a Zeiss objective 40. A micro-pipette was raised into the culture, and a small quantity of fluid allowed to run in. Single organisms were then expelled, by means of a hand bellows, on to different parts of the surface of the agar, each single germ being ringed with a diamond. As a rule ten to twelve such isolations were made on each micro-plate. Anaerobiosis was produced by Fortner's method, the most satisfactory results being obtained by thickly spreading a young (eighteen hours) *B. prodigiosus* culture on the concavity of a hollow-ground slide. The inoculated cover-slip was luted over this depression with vaseline. In most instances division of the germs was evident in three or four hours; in one timed experiment the observed bacillus commenced to elongate in one and a-half hours, division being complete in two hours. The micro-plates were incubated at 37° C. for twenty-four hours, when, if positive, colonies of 1 to 3 mm. were obtained. In no instance was growth obtained after forty-eight hours if negative at the twenty-fourth hour. The isolation scheme followed was:—

Lamb dystentery bacillus.—m.b. — s.c. — col. — m.b. (1); s.c. — col. — m.b. (2); s.c. — col. (3); s.c. — col. (4); s.c. — col. — m.b. (5).

B. paludis.—m.b. — s.c. — col. — m.b. (1); s.c. — col. — m.b. (2); s.c. — col. — m.b. (3).

B. welchii.—m.b. — s.c. — col. — m.b. (1); s.c. — col. — m.b. (2).

(m.b. = meat-broth culture; s.c. = single cell; col. = colony resulting from a single cell.)

The toxins were made by incubating the organisms in meat broth for eighteen hours, filtering the culture through a Berkefeld candle and saturating the filtrate with ammonium sulphate. The precipitate so obtained was pressed, dried *in vacuo* over sulphuric acid and thoroughly pulverised.

The antitoxins against L.D. (s.c.),* paludis (s.c.), and welch (s.c. and original) were made in goats by the subcutaneous injection of formol-toxoid followed by toxin. The L.D. (original) antitoxin was prepared in a horse, and the paludis (original) antitoxin in a rabit, both at the Wellcome Physiological Research Laboratories. Mice injected intravenously were used for all toxin-antitoxin titrations; mixtures were allowed to stand for one hour at room temperature (22°–27° C.) prior to injection. Readings of "lives" and "deaths" were made at the end of twenty-four hours.

* The following abbreviations will be used: L.D. = lamb dysentery bacillus; paludis = *B. paludis*; welch = *B. welchii*; original = cultured, not single-celled; and s.c. = single-cell culture.

Morphological and Cultural Characters.

Morphologically both the original and s.c. cultures of the three germs were indistinguishable, and answered to descriptions of classical *B. welchii*. In media such as meat broth, von Hibler, and 1 per cent. glucose broth, all strains behaved like *B. welchii*, except that the welch culture was often somewhat mucoid in consistency. The same applied to surface cultures, with the exception that the paludis strains produced flatter and more transparent colonies than typical *B. welchii*.

Alkaline Egg Medium.—All strains produced a clot within seven days.

Loeffler's Serum Medium.—All cultures softened the medium in seven days, and partially (half and three-quarters) liquefied it within one month.

Inspissated Serum (horse).—No change was produced by the L.D. or paludis organisms. After one month the welch strains caused a slight softening at the lower (thicker) portion of the medium, but no true liquefaction.

Fermentation Reactions.—All strains fermented with acid and gas production, saccharose, galactose, glucose, lactose, lævulose, maltose, dextrine, inosite and raffinose. All were negative in salicin, adonite, dulcite, sorbite, inulin and mannite, but on three occasions, paludis (original) produced a trace of acid reaction with a bubble of gas in salicin.

Glycerine.—Both L.D. cultures were negative (pH=7.5). The others fermented this " sugar " with acid and gas formation (pH=5.5).

Litmus Milk.—A " stormy fermentation " was produced by all organisms within twenty-four hours.

Gelatine.—Liquefaction was caused by all cultures.

The methyl red reaction (in 0.5 per cent. glucose broth) was positive, the carbinol reaction (in the same medium) was negative, and the indol reaction in peptone water was negative for all strains. Nitrates were reduced to nitrites by both the paludis cultures and by the L.D. (s.c.) strain ; the remainder failed to do so.

Aldehyde and Acrolein Reactions (Humphreys, 1924). These tests could not be carried out, as glycerine free from aldehyde could not be obtained.

Simple Animal Test.—The intramuscular injection of guinea-pigs with from 0.1 c.c. to 1 c.c. of a young meat broth culture produced death in from twelve to twenty-four hours. As L.D. and paludis produce much more potent toxins than welch, it was necessary to grade the dose of culture injected, so that death was caused not by the toxin injected, but by toxin formed *in vivo*. When this precaution was adopted, the post-mortem picture was practically the same for all strains, and did not materially differ from that described for classical *B. welchii*.

Toxin-Antitoxin Neutralisation.—All dry toxins were dissolved in saline in the proportion of 100 mg. to 5 c.c., and their toxicities established in mice by intravenous injection. No attempt was made to have the same number of fatal

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TABLE I.

Antitoxins.	Toxins.				
	L.D. (s.c.)	L.D. (orig.)	Pal. (s.c.)	Pal. (orig.)	Welch (s.c.)
L.D. (orig.)	(T.D. = 0.5 mg.) 0.005 c.c. ** 0.004 c.c. ** 0.0035 c.c. †† 0.003 c.c. ††	(T.D. = 2.0 mg.) 0.0037 c.c.*** 0.0030 c.c. †††	(T.D. = 1.0 mg.) 0.007 c.c. *** 0.006 c.c. *** 0.005 c.c. *†††† 0.0045 c.c. †††	(T.D. = 2.0 mg.) 0.012 c.c. *** 0.01 c.c. ***† 0.008 c.c. ††† 0.075 c.c. †††	(T.D. = 2.0 mg.) (13–14 M.L.D.) 0.1 c.c. ** 0.03 c.c. ** 0.01 c.c. ††
L.D. (s.c.)	(T.D. = 0.5 mg.) 0.017 c.c. ** 0.015 c.c. **† 0.012 c.c. †† 0.01 c.c. ††	(T.D. = 2.0 mg.) 0.017 c.c. *** 0.015 c.c. *†††† 0.012 c.c. †††† 0.01 c.c. †††	(T.D. = 1.0 mg.) 0.02 c.c. **** 0.017 c.c. *†† 0.015 c.c. ††† 0.012 c.c. ††	(T.D. = 2.0 mg.) 0.04 c.c. *** 0.035 c.c. *s†† 0.03 c.c. †††† 	(T.D. = 2.0 mg.) 0.1 c.c. ** 0.03 c.c. †† 0.01 c.c. †
Pal. (orig.)	(T.D. = 0.2 mg.) 0.02 c.c. ** 0.017 c.c. ** 0.015 c.c. *†† 0.012 c.c. ††	(T.D. = 2.0 mg.) 0.05 c.c. ** p.04 c.c. *** 0.035 c.c. †† 0.03 c.c. ††	(T.D. = 0.4 mg.) 0.02 c.c. *** 0.017 c.c. *†† 0.015 c.c. ††† 0.012 c.c. ††	(T.D. = 2.0 mg.) 0.12 c.c. *** 0.10 c.c. ****† 0.09 c.c. *† 0.08 c.c. †††	(T.D. = 2.0 mg.) 0.1 c.c. ** 0.03 c.c. †† 0.01 c.c. ††
Pal. (s.c.)	(T.D. = 0.5 mg.) 0.005 c.c. **** 0.0045 c.c. *†† 0.004 c.c. ††† 0.0035 c.c. ††	(T.D. = 2.0 mg.) 0.006 c.c. **** 0.005 c.c. **†††† 0.0045 c.c. †††† 0.004 c.c. †††	(T.D. = 1.0 mg.) 0.007 c.c. ** 0.006 c.c. ** 0.005 c.c. †††† 0.0045 c.c. ††	(T.D. = 2.0 mg.) 0.017 c.c. ** 0.015 c.c. **** 0.012 c.c. †††† 0.01 c.c. ††††	(T.D. = 2.0 mg.) 0.03 c.c. ** 0.01 c.c. ** 0.0 03 c.c. ††
Welch (s.c.)	(T.D.=0.006 mg.) 1 M.L.D. 0.1 c.c. ††††	(T.D. = 0.02 mg.) 1 M.L.D. 0.1 c.c. †††	(T.D. = 0.01 mg.) 1 M.L.D. 0.1 c.c. ††††	T.D. = 0.01 mg.) 1 M.L.D. ††	(T.D. = 2.0 mg.) 0.03 c.c. ** 0.01 ** 0.003 c.c. ††

T.D. = test dose. M.L.D. = 1 sure minimal fatal dose. * = Live. † = Death. s = Sick.

doses per test dose, but care was taken that each test dose contained a " sufficiency " of lethal units. Tables I and II record the various titrations, and Table III the ratios of one toxin to another and of one antitoxin to another. Close limit titrations were not carried out with welch toxin against the various antitoxins ; the fact that all sera definitely neutralised this toxin was demonstrated.

Previous work (unpublished) has clearly shown that the " L.D. or paludis antitoxin value " of a serum bears no relation to its " welch antitoxin " value.

TABLE II.

Toxins.	Antitoxins.
Paludis (s.c.), 1 M.L.D. ...	Welch, vibrion septique, œdematiens, histolyticus, and botulinus A, B, C, D and Seddon, 0.025 c.c. of each †††
,, ...	As above, plus 0.025 c.c. L.D. (s.c.) antitoxin. ***
,, ...	As above, plus 0.025 c.c. Paludis (s.c.) antitoxin. ***
,, ...	*Nil.* ††
L.D. (s.c.), 1 M.L.D. ...	Titrations as above, with identical results.

TABLE III.

		Toxins.				Neutral Point Ratio (Toxins)			
		L.D. (s.c.) A	L.D. (orig.) B	Pal. (s.c.) C	Pal. (orig.) D	A/A	B/A	C/A	D/A
Antitoxins	L.D. (s.c.) A	0.017	0.017	0.020	0.040	1.0	1.00	1.18	2.35
	L.D. (orig.) B	0.0045	0.0037	0.006	0.010	1.0	0.82	1.33	2.22
	Pal. (s.c.) C	0.005	0.006	0.006	0.015	1.0	1.20	1.20	3.00
	Pal. (orig.) D	0.0425*	0.040	0.050*	0.100	1.0	0.94	1.18	2.35
Neutral point ratio (antitoxins)	A/A	1.0	1.0	1.0	1.0	Means	0.99	1.22	2.48
	B/A	0.26	0.22	0.30	0.26	0.26			
	C/A	0.29	0.35	0.30	0.37	0.33			
	D/A	2.5	2.4	2.5	2.5	2.5			

The first four rows give the neutral points and neutral point ratios of the toxins for each of the antitoxins, while the first four columns give the neutral points and the neutral-point ratios of the antitoxins for each of the toxins.

* The neutral point figures given in Table I have been multiplied by 5/2 since the test dose of toxin was 2/5 of that used for the other titrations.

Discussion.

With the exception of two cultural reactions, that of the clotting of alkaline egg medium and that of the liquefaction of solid serum, the results here recorded agree very closely with those already published. The serological reactions of L.D. and paludis toxins, whether from " unpurified " or single-cell cultures, confirm the previous findings of Mason, Ross and Dalling (1931). No guinea-pig immunisation was carried out in this investigation, but there is no reason to believe that the single-cell paludis toxin would behave differently from that of the original toxin. Reference to Table I shows that all sera neutralise welch toxin, that the L.D. toxins are neutralised by their own and by the paludis antitoxins, and that the paludis toxins are neutralised by their own and by the L.D. antitoxins. Table II shows that mixtures of a number of antitoxins prepared against anaerobes other than L.D. or paludis are unable to neutralise one sure fatal dose of either L.D. or paludis toxins. The data in Table III (for which I am indebted to my colleague, Mr. C. M. van Wyk, M.Sc.) show that the ratio

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of the one toxin to the other, and of the one antitoxin to the other, is reasonably constant within the limits of the test. There is thus strong experimental evidence for stating that :

(1) In the toxic filtrates of the L.D. bacillus, *B. paludis* and *B. welchii*, there is a common antigen, *viz.*, that which is neutralisable by *B. welchii* antitoxin.

(2) (*a*) This antigen constitutes, from the evidence available, all the *B. welchii* toxic fraction. (There are, however, no grounds for saying that this *B. welchii* antigen will not by appropriate technique be shown to consist of more than one fraction). (*b*) No " true " L.D. toxin has been demonstrated in *B. welchii* toxic filtrate. If present, it is in too small amount to stimulate the production of L.D. antitoxin in animals. This is unlikely, as previous work has shown that L.D. filtrate containing barely appreciable amounts of *B. welchii* hæmolysin will produce an antitoxin of a moderately high anti-welch value.

(3) There is in both L.D. and paludis filtrates, apart from the welch toxin, a common antigen which, from the results available, is the chief fraction of each toxin. The antitoxin produced by this main L.D. or paludis fraction is identical.

Thus in both L.D. and paludis toxic filtrates there are two antigens : the main or " true " L.D. toxin and the subsidiary or welch toxin. As with " pure " welch toxin, it cannot be said that these are the only antigens. Wilsdon has shown that his Group 2 (L.D.) shares a factor with his Group 4 not possessed by his Group 3 (paludis). Further, an investigation by Dalling and Mason (summarised by Dalling, 1932) on Bennett's (1932) *B. ovitoxicus*, showed that although the toxin of this germ had serological properties in common with L.D. toxin, yet there was evidence that the two toxins were not identical. However, although future work may reveal serological differences between the toxins of the lamb dysentery bacillus and *B. paludis*, one may conclude that the chief fraction of each is identical, and further, that each contains a varying amount of *B. welchii* toxin.

The clotting of alkaline egg medium is not, in the writer's opinion, a significant method of distinguishing the L.D. bacillus from *B. welchii*. A number of experiments using several strains of *B. welchii* has shown that the occurrence of clotting depends greatly on the consistency of the medium. If gelatinous, coagulation will probably occur ; if limpid, this reaction may or may not be obtained. None of the L. D. or paludis cultures liquefied solid serum, this being at variance with former results. One explanation is that formerly both cultures were contaminated with a proteolytic germ, and have ultimately " purified themselves " in routine sub-cultures or platings. Whilst this is possible, the author is inclined to think that in previous work Loeffler's serum medium has been used instead of solid serum, and that the strain of *B. welchii*, commonly used for comparison, was devoid of liquefying even Loeffler's serum. Further, McEwen reported his germ as a non-serum liquefier. Finally, it is to be noted that only three strains have been used in this investigation. The use of more might possibly reveal further

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cultural and serological variations; however, as each is representative of its group, the results here recorded can be regarded as the reactions of " standard " strains.

Summary.

(1) Single-cell cultures have been prepared from the lamb dysentery bacillus *B. paludis* and *B. welchii*. (2) Morphologically these germs cannot be distinguished one from the other. The only cultural difference is the fermentation of glycerine by *B. paludis* and *B. welchii*, and the failure to do so by the lamb dysentery bacillus. (3) No strain liquefied inspissated horse serum, and all clotted alkaline egg medium. The reactions in these media do not distinguish the one germ from the other. (4) The antitoxins of the lamb dysentery bacillus and *B. paludis* (both original and single-cell cultures) neutralise the toxin of *B. welchii*. *B. welchii* antitoxin does not neutralise the toxins of these anaerobes. (5) Serologically the chief fraction of the toxins of the lamb dysentery bacillus and *B. paludis* (both original and single-cell cultures) is identical.

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Clinical Articles

OTITIS MEDIA, WITH COMPLICATIONS, IN A HORSE.

By LINDSAY AUCHTERLONIE, M.R.C.V.S., and E. J. GILROY GLASS, F.R.C.S.E.

Nottingham.

OTITIS MEDIA, with the complications of facial nerve palsy, acute suppurative labyrinthitis and meningitis, occurring in a horse, would appear sufficiently unusual to justify the presentation of the following case, together with the post-mortem findings.

Clinical Note (L.A.)

The subject, a fifteen-year-old gelding of the single railway vanner type, was in good condition and working regularly until the commencement of its ear symptoms in March of this year. The earliest symptom noted was on March 15th, when the foreman horsekeeper noticed that the horse resented having his collar

put on, or any attempt to handle his left ear. I saw the animal for the first time on March 22nd, when I was called in on account of " pus coming out of the ear, and the horse not eating well." The left ear was full of dirty-yellow pus, which was trickling over the surrounding skin, and there was marked œdema and tenderness below the ear. Mastication and swallowing appeared to cause pain.

The treatment adopted was, firstly, daily free irrigation with hydrogen peroxide (20 vol.) diluted 1 in 7, to break up the firmer portion of the pus adherent to the cavity of the ear, and, secondly, careful swabbing with wool, followed by the spraying in of liquid zinci. chlor., 1 in 32. Following this the ear was again swabbed out as dry as possible. Improvement under this treatment was apparently consistent in that the discharge became less while the swelling and discomfort abated, so that by April 15th only a little inspissated pus could be obtained by inserting the finger deep into the meatus, and it appeared that ultimate work for the horse was not far distant.

On April 21st, however, he had a relapse: the base of the ear swelled up, and the otorrhœa became as profuse as before and, in addition, left-sided facial palsy was evident, the upper lip being dropped and twisted to the right and the lower lip sagging. On April 24th, he had what the foreman called a " fit," in which he thought the horse would die. He described this as " staggering round the box, propping his legs, and moving his head in an aimless manner." When I saw him some three hours later he was attempting to eat some hay, but quite evidently with insufficient power to masticate. The facial paresis was much more marked, and there was definite though slight wasting of the masseter muscle. There was slight inco-ordination of all four limbs, the eyelids drooped, and he salivated. The following day sanction was obtained to destroy the animal. This was accomplished with some difficulty, as a return of the acute symptoms of the previous day coincided with the arrival of the slaughterman. The horse reeled about the box, and leaned against the wall. He then stood with legs propped and head moving aimlessly about, so that it was only with difficulty that the " killer " could be placed in position. I regret that I was absent on both occasions when acute nervous symptoms were in evidence, but the description of the foreman was graphic, and may be relied on.

Pathological Note (E.J.G.G.)

The autopsy was confined to an examination of the left half of the skull from which the soft parts had been partly removed. The naked-eye appearance of the meninges showed the injection of early meningitis, which was practically confined to the left side of the cerebrum and most marked on the lower aspect (L.A.). The middle ear was opened from above, and found occupied by a mass of flabby granulation tissue extending into the mastoid process and para-mastoid process, and eroding the bone to such an extent that only a thin shell remained on the outer aspect. Lying loose in the granulation tissue was a large sequestrum composed of the whole of the annulus tympanicus and part of the bulla ossea. No trace of the membrana tympani or malleus could be found, though careful

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Elephantiasis of the Scrotum.

* Exit of canal where penis is embedded, *i.e.*, on left side of upper third of tumour.

(*Article by* Edward Morgan, *page* 233)

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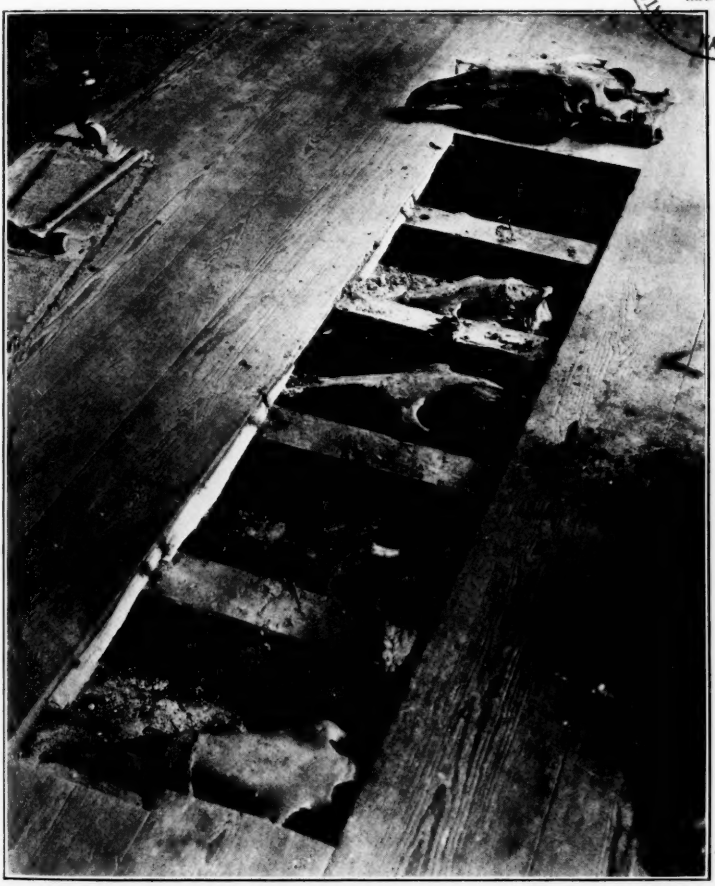

Curious find of horse skulls under the floor of a house at Bungay, Suffolk.

(*Letter on page* 239)

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search was made for them. The incus was found, and showed well-marked caries. The stapes was *in situ*, but this also was carious, and could only be recognised by its position.

The internal ear was opened from the outer aspect. The cochlea was full of blood-stained pus, and this condition extended into the vestibule and semi-circular canals. The internal auditory meatus had unfortunately been damaged in the removal of the specimen, and no opinion could be formed of any morbid condition of this area. The facial nerve was traced from above the internal ear throughout its bony course. The canal was intact, and the nerve appeared normal to the naked eye as far as a point one inch proximal to the stylo-mastoid foramen, but from this point onwards the canal was eroded, and the nerve, which was lying free in the granulation tissue, was red and swollen. The aural end of the Eustachian tube was blocked by granulations, and when these were removed the walls appeared to be greatly swollen though the tube was patent.

Pathologically this case coincides with the similar condition in the human, but it is rather less easy to compare the clinical pictures in the two subjects. It would appear, however, that in the initial stage (March 15th to 22nd) there was an acute inflammation of the middle ear and surrounding bone. During the stage of apparent improvement the sequestrum must have been separating. On April 21st, there was evidently further spread to the facial canal, and the first " fit " possibly corresponds to the initial invasion of the labyrinth. In the human such invasion would be characterised by vertigo, nystagmus and vomiting. In the lower animals the nystagmus is associated with head movements, while the vertigo is revealed by reeling gait and apparent inco-ordination : thus the picture of the fit might well have a parallel here. The last fit might be either a continuation of labyrinthine symptoms, or signify invasion of the meninges through the internal ear, the route most common in the human.

ELEPHANTIASIS OF THE SCROTUM IN THE HORSE.

By EDWARD MORGAN, F.R.C.V.S., D.V.H.
Venezuela.

" ELEPHANTIASIS is a chronic inflammatory hypertrophy of the fibrous connective tissue of a region of the body induced by lymph stasis and resulting in a considerable hypertrophy of the skin and subcutaneous tissue."—*Castellani and Chalmers.*

" Elephantiasis is a disease known to be produced by or associated with *Filaria bancrofti*."—*Manson.*

Anderson believes that the adult filariæ living in the lymphatic system, by the damage they produce in the intima of the vessels, so prepare the way that a streptococcal or staphylococcal infection, however mild, is able to obtain a foothold, and that by the changes thus produced the lymph channels become further

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occluded. In these ways one can explain the production of elephantiasis by the filariæ, and the absence from the blood of the embryo of the parasite which started the disease. The latter cannot pass the occluded glands. Castellani and Chalmers state that it is true that a secondary bacterial infection may possibly assist the development of the disease, for a diplococcus has been found by Dufogere which he calls the " lymphococcus," and his findings have been confirmed by Foulerton. Le Dantec describes a similar organism which he calls the " dermatococcus," but the main cause of elephantiasis in the tropics is *Filaria bancrofti*, though it is quite possible that, exceptionally, other causes may lead to occlusion of lymphatics and the formation of elephantiasis, according to information which I have received recently from my medical friends in Venezuela.

Anatomical Structure.—These tumours consist of two portions: first, a dense rind of hypertrophied skin thickest towards the lower part and gradually thinning out as it merges above into the sound skin of the pubis, perineum and thighs; second, enclosed in the rind, a mass of lax, blubbery, dropsical, areolar tissue in which testes cords and penis are embedded.

Although having turned the index-leaves of all the veterinary literature I have to hand, I am unable to find that scrotal elephantiasis figures as a disease occurring in the horse or in any of our domesticated animals. Nevertheless, I venture to use the term in connection with three cases I have recently met in the horse which my medical friends in Venezuela call elephantiasis, as they find these growths similar to the disease which is prevalent in human beings in various districts of this country. A glance at the picture of one of the cases should give an idea of the appearance of the growth, which at first sight might be diagnosed as hernia.

Case 1.—A nine-year-old stud horse belonging to the President of the Republic. This horse was out in the fields until the growth had reached to such a size that the horse was unable to serve mares. I was then consulted and asked to operate. The animal was prepared in the usual way, free of food, etc., and then cast and chloroformed. Unfortunately my only assistants were a few cowboys who had never seen an animal being put to sleep except by means of a knife or a gun. As a rule they are good hands at casting and securing the legs, so I entrusted this work to them in order to prepare the other necessaries for the operation. I discovered, much to my regret, when I was half way through the operation, that one must not even trust the cowboys' knots, as one hind leg got loose, but fortunately at the moment only the skin on one side of my face suffered through being grazed, but before I finished the operation my eye was closed with the swelling. Manson, in Castellani and Chalmers' book, states that the only treatment for scrotal elephantiasis in man is removal, so I endeavoured to carry out his instructions, which are as follows:

The most important feature of the whole operation is to have the skin perfectly clean and aseptic, and to carefully choose the parts of the skin which are to be used as flaps. An elastic tourniquet in a figure of eight is applied round

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the pelvis, and the neck of the tumour. The skin flaps are now marked out and deepened, the vessels being carefully ligatured as they are exposed. The testicles are then dissected by perpendicular cuts, and the penis is set free by dissection after cutting down the canal, which is formed by the prepuce.

The general mass of elephantoid tissue is now cut away, gradually ligaturing the vessels as the cutting process goes on, thus preventing the omission of any of the vessels. The tourniquet is now loosened, and any bleeding spot secured. The flaps are now brought together and stitched over the testes, and drainage tubes inserted. Skin flaps should, if possible, be made for the penis; failing this, the raw area must be covered with protective dressing and allowed to granulate. The whole wound must now be antiseptically dressed, and usually heals without difficulty. I found when stitching the skin flaps that I had been a little too free with my scalpel; nevertheless, I managed to get the ends to meet by means of Carlton Reeks' wire skewers, which are as well known in the districts I travel in Venezuela as they are in the Spalding district of Lincolnshire. Finally, I applied a suspensory bandage, but the following day I found it out of place and stained with manure and urine, so it was afterwards abandoned. This growth was not weighed, but I calculate it to be about 8 lb. The wound healed completely in about six weeks. The horse is again used for breeding purposes.

Case 2.—Owner a Frenchman. Four-year-old Andalusian entire horse used for stud purposes. The case was almost identical with Case 1. Fortunately this horse was sent up to our own farm so as to get every possible attention. The animal was returned cured to the owner the first week in April. It was operated on about the end of February.

Case 3.—An eight-year-old grey saddle gelding, *vide* photograph. Owner—General Antonio Pimentel. This horse had been castrated about two years ago. The man who castrated informed the owner at the time that he noticed upon cutting through the scrotum a peculiar doughy swelling. They kept the horse under observation for a few days after castration, thinking that it might be a case of rupture. Eventually the horse was turned out to an extensive sabana with other horses, and in a few weeks' time it was quite evident that the swelling was increasing in size, and continued to increase for two years. The case being of interest, I took a famous surgeon along with me to see the horse, and when he volunteered to come and assist me, I immediately accepted. He had recently operated on several cases of the kind in human beings.

The operation was carried out almost in the same way as recommended by Manson. My surgeon friend had a surprise when the blood vessels were acting like Venezuelan oil springs when tapped. We used about a dozen artery forceps as well as ligaturing. The operation lasted over two hours, but the horse slept on for another six hours, when he eventually woke up and got on his feet, this being a long time for a horse to take to recover from the effects of chloroform. For about a week everything seemed to be going on satisfactorily, but afterwards gangrene set in, and the animal died on the tenth day after the operation. The

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tumour, apart from small parts which we removed, weighed over 35 lb. If this case had been left to run its course, probably it would have increased to such a size and weight that the animal would have been unable to bear its weight. Elephantiasis of the scrotum in human beings may attain an enormous size, from 10 to 50 lb. is not uncommon. There is one case on record of having reached the weight of 224 lb.

Abstracts of Current Literature

What Has Been Learnt from Six Years' Practical Application of B.C.G.—Ascoli. *Annales de l'Institut Pasteur*, XLVII, July, 1931, p. 29. *Rev. Gén. de Méd. Vét.*, March 15th, 1933, p. 157.

Ascoli has already shown that subcutaneous inoculation of B.C.G. has the effect of attracting towards the local focus thus created the microbian germs that are in circulation in the humours of the system. He has given the name of anachoresis to this phenomenon. This fact is most evident in young calves vaccinated in the dewlap, thus generally protected against different maladies frequent in rearing, for example, broncho-pneumonia and infections by ovoid bacteria. As a result vaccination with B.C.G. diminishes the morbidity and mortality in vaccinated calves compared with those not vaccinated ; *the vaccinated develop better and resist illness better than the controls.* Besides specific immunity there is also a non-specific immunity which one can compare to the effects of the abscess of fixation.

The Best Vermifuges of the Large Intestine in the Horse.—Professor Marotel, *Rev. Vét. et Journ. de Méd. Vét.*, February, 1933.

Professor Marotel has experimented with vermifuges against strongyles and cylicostomes infesting the large intestine in the horse. His tests were made on twenty-five horses, and he used six vermifuges on them. He wanted especially to discover *the best cæcal vermifuge.* His observations were carefully made, and based on the microscopic enumeration of the eggs of the worms contained in the excrement *before and after treatment.* Before treatment the subject was put on a relatively long (twenty-four to thirty-six hours) hydric diet in order to empty the large intestine (always more infested than the small) and thus to lessen the dilution of the remedy. The vermifuges tried were carbon tetrachloride, tetrachlorethylene, vermifuge Lagaillarde, terebenthino-benzol, pyrethrine and thymol. He came to the following conclusions : (1) The two best agents against cæcal strongyles are commercial products called Didakol and Lagaillarde. (2) Didakol is tetrachloride of carbon. It was given as a draught in an average dose of 50 c.c. diluted in a mixture of castor oil and medicinal paraffin (100 c.c.

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of each). Cost per horse, 12 francs. (3) Lagaillarde is made up of essence of turpentine, 100 ; chloroform, 20 ; castor oil, 300 ; A hypodermic injection of arecolin is given immediately after giving the remedy. At first this medicine was given with a syringe, but later on it was administered as an electuary (essence of turpentine, 100 ; chloroform, 20 ; aloes, 20). Cost per horse, cheaper than No. 2. (4) Whatever the therapy chosen, dieting ought to be fairly long : twenty-four to thirty-six hours before treatment, and six hours after. The author writes that the modest price of these remedies entitle them to be used not only curatively, but as preventives, in order to eradicate verminous typhlo-colitis in rearing districts where these affections are epizootics.

Epidural Anæsthesia in the Dog.—J. CUILLE and P. CHELLE. *Rev. Gén. de Méd. Vét.*

THIS operation may be practised by the sacral way or the lumbo-sacral way. Sacral anæsthesia is performed by puncture at the site of the sacro-coccygian space, that is at a point where the transversal line joining the two coxo-femoral articulations crosses the median line. One uses for this a nickel needle 3 to 4 cm. long and 1 mm. in diameter, and one injects for a medium-sized dog, according to the extent of anæsthesia desired, 2 to 10 c.c. of either one or other of the two following solutions : For operations of short duration : Novocaine, 0.10 gr. ; chloride of sodium, 0.06 gr, ; distilled water, 10 c.c. For longer operations up to two hours and a-half : Novocaine, 0.30 gr. ; adrenalin solution (1 per cent.), 5 drops ; chloride of sodium, 0.05 gr. ; bicarbonate of sodium, 0.08 gr. ; distilled water, 15 c.c.

With 10 c.c., anæsthesia extends to the anterior limbs, whose sensibility is materially decreased. It is prudent for dogs of average size not to reach a dose of 15 c.c., which may become dangerous ; the anæsthesia ascending the rachidian canal up to the diaphragmatic nerve formed by the branches issuing from the fifth and sixth pairs of cervicals may, by paralysis of this latter, cause complete stoppage of circulation. Sacral puncture demands a certain deftness. Faults are more frequent in the dog than in any other animal on account of false routes outside the rachidian canal. Cuille and Chelle have sought to find a surer and safer way of reaching the epidural cavity, and have found it at the site of the lumbo-sacral space.

The lumbo-sacral way is an excellent method of reaching the epidural space : the dural cone ends in fact at the level of the last lumbar vertebræ. The place of choice for injection is situated on the transverse line which joins the two antero-internal angles of the ilium. The puncture is made with a steel needle 5 c.c. long and 1.3 mm. diameter. One assures oneself before injection, by a slight aspiration of the syringe, that no cephalo-rachidian liquid enters it, and as a result the needle has not penetrated into the dural cone. One then injects a quantity of the identical anæsthetic solution as that previously indicated for anæsthesia by the sacral way.

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On the Results of Anti-Tuberculous Vaccination by B.C.G. in Austria.—GERLACH. *Zentralblatt für Bakteriologie*, CCVI, 1932, p. 191. *Rev. Gén. de Méd. Vét.*, March 15th, 1933, p. 157.

SINCE 1925 more than 4,000 calves have been vaccinated in Austria with B.C.G., a good part of these animals having received the B.C.G. for the third and fourth time. It arises from this long experience that the method in bovines is quite harmless. The reaction to the vaccine shows only a local œdema which is rapidly and completely absorbed. No other phenomenon has been observed. The vaccination is effective : no deaths from tuberculosis have occurred in bovines immunised. Further, no vaccinated animal has shown tuberculous lesions, either open or generalised. Nevertheless, as far as one can see, vaccination by B.C.G. does not confer absolute immunity at all as regards tuberculous processes.

Pancreas Concretions in the Cow.—Dr. C. DE GRAAF. *T-jd. voor Diergene.*

IN two bovines, which for the rest were quite healthy, inspection after slaughtering revealed accidentally the presence of stones (lithiasis) in the pancreas. The number of stones ran into hundreds. The size varied from that of a pin's head to that of a pea, the colour was marble-white. Chemically they appeared to consist of about 85.45 per cent. calcium carbonate, 2 per cent. calcium phosphate, and 8.44 per cent. magnesium carbonate.

White Diarrhœa of Chicks.—LAHAYE. "Annales de Médecine Vétérinaire," December, 1931. *Recueil de Méd. Vét.*, March, 1933.

AFTER discussing sero-agglutination for the detection of carriers, Lahaye comes to the conclusion that this method is slow, troublesome and difficult, and the results not constant. He favours pullorination, and considers that variations in the preparation of pullorine used are the cause of any unsatisfactory results. He gives three principal forms of pullorine : (1) A physiological suspension of killed bacilli, of which one knows neither the concentration nor the method of determining or fixing it. (2) An alcoholic precipitate of bouillon culture deprived of its organisms. This precipitate is dried, powdered and then dissolved in sterile water before use. (3) A bouillon culture of *B. pullorum* several weeks old and deprived of its germs by filtration. From the experience of the author and those of his *confrères* it is found that pullorine II almost certainly eliminates all the carriers, and it is recommended.

The medicinal treatment which has given the best results consists in the giving of the following : ℞ Liq. ferri. perchlor., 17 minims ; sulphate of quinine, 1½ drachms ; bichromate of potash, 1 ounce ; water to three pints. Dose : a tablespoonful to each three pints of drinking water. This is the maximum dose for chicks less than ten days old, and they receive it in the course of seventy-two hours. In chicks among which there is pronounced infection, one can give the

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mixture when they are forty-eight hours old. Its efficacy is such that it merits use either as a preventive or curative. Hygiene should be extensive and accompany any methods of treatment. It consists in avoiding infection by fæcal matter, and pollution of water and food. This latter condition is easily realisable by suitable model feeding and drinking troughs. The elimination of fæcal matter can be brought about by putting the chicks on a double floor of wire netting.

The important points as regards prophylaxis are: (1) Eliminate the carriers of germs by bi-annual pullorination. (2) Maintain the health of the flock by the incubation of eggs provided exclusively from subjects recognised as healthy by two successive pullorinations; disinfection of the shells of the eggs; sub-division of the incubators into compartments containing at the maximum 100 eggs; treatment of chicks with skim milk and the bichromate of potash solution; rearing on wire netting and compulsory quarantine during which pullorination is practised on all fowls introduced.

Correspondence

A PECULIAR FIND OF HORSE SKULLS.

To the Editor of THE VETERINARY JOURNAL.

SIR,—In March, 1932, while staying in some rooms at Bungay, the owner told me that having occasion to take up a board in the one I was occupying as a dining room, some horses' heads had been thrown out, but no other bones of any kind. I was much interested, and made many inquiries which were quite unsuccessful; and the heads had vanished. However, the lady kindly promised that should the particular room be unoccupied later on she would allow me to have a piece of the flooring removed. The opportunity occurred last month, and needless to say a carpenter was sent for. He removed some boards on the ground floor, and between the joists were found rows of horses' skulls, laid with great regularity, the boards resting immediately upon them so that they were immovable. Only two boards were taken up, but there appeared to be skulls as far as one could reach, and some years ago when this and the adjoining house were undergoing repair, several horses' skulls were thrown out.

In the room above-mentioned there may be thirty to forty, if the floor is entirely laid with them, and there appear to be no other associations with them. Eight have been taken out. The house is old, and is supposed to have been standing before 1688, when Bungay was almost completely destroyed by fire. It is below the level of the present roadway some eighteen inches or two feet. The flooring is in good condition, and is, I am told, of red pine; the joists are of oak, some of which have quite rotted away. I enclose a photograph [reproduced facing page 232], but as the heads had been taken out previously and replaced, it does not give quite the idea of the great regularity in which they appeared when first brought to view. Each head rested directly on the earth with the incisor teeth supported on a small block of oak or stone, so firmly wedged between the ground and the flooring that the carpenter had to knock them away with a hammer.

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Could they have been placed there for drainage ? I shall be very glad if any light can be thrown on the subject.

(MRS.) H. E. MANN.

Earsham Street, Bungay, Suffolk.
March 17th, 1933.

[The above is of especial interest to the Royal Veterinary College, as the late Professor John Beart Simonds, who was Principal of the College between 1872 and 1881, was in practice there when offered the College appointment.—*Editor*, THE VETERINARY JOURNAL.]

Reviews

An Eye for a Horse. By Lieut.-Colonel SIDNEY G. GOLDSCHMIDT. London: Constable & Co. Price 10*s*.

A GREAT deal has been written on this question, but few books will be more welcomed than Colonel Goldschmidt's recent publication. It will be appreci ted by every section of the horse-interested public. The name of Colonel Goldschmidt is enough to recommend it. Careful study and observation, knowledge, and practical experience is the keynote of " An Eye for a Horse." Not only have we the expert's opinion, but that of a man who loves his subject—the horse. His book is concise, well arranged as a study, yet interesting reading as a story, from cover to cover. It contains photographs and diagrams to explain his theories. Colonel Goldschmidt deals with the question, and we shall benefit by his advice, of buying wisely, and making the best selection of a horse ; and he warns us of the pitfalls of ignorance and the astuteness of the seller. Long experience has formed his opinion of the supreme value of the thoroughbred—be it hunter or polo pony. Good breeding alone produces the perfection of conformation and balance, beauty and speed, the power to stay and carry weight. He deals with the individual conformation of limb and bone, to make up the perfect whole, laying stress on the quality of the 15.2 thoroughbred in preference to the bigger horse of heavier bone.

Chapter III outlines the history of English horse breeding and racing from an early date, including the story of the Great Eclipse, the Arab sires imported by our forefathers, whose blood brought quality, speed and endurance, and he mentions other great horses whose names have brought glory to the records of the English turf. If Colonel Goldschmidt teaches us to see and understand a horse through the wisdom of his eyes, he will be adequately repaid for the trouble he has taken to give the public this careful summary of his knowledge and experience. E. K. T.

R.A.V.C. ANNUAL DINNER.

The Annual Dinner of Officers of the Royal Army Veterinary Corps, past and present, Regular, Territorial and Ex-Temporary, will be held at the Hotel Victoria, on Friday, June 9th, at 8 p.m. Gentlemen desirous of attending should inform the Honorary Secretary, R.A.V.C. Dinner, War Office, Whitehall, London, S.W 1, as early as possible.

THE R.V.C. STUDENTS' UNION MAGAZINE.

Post-Graduates who are interested in the activities of the students of the Royal Veterinary College, London, will be pleased to hear that the Students' Union Annual Magazine is due to appear at the end of May. The magazine contains details of the various clubs connected with the Union, together with articles subscribed by the students. Copies can be obtained, post free, at 1*s*. 6*d*. each from the Editor, The Royal Veterinary College, Camden Town, London, N.W.1.

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